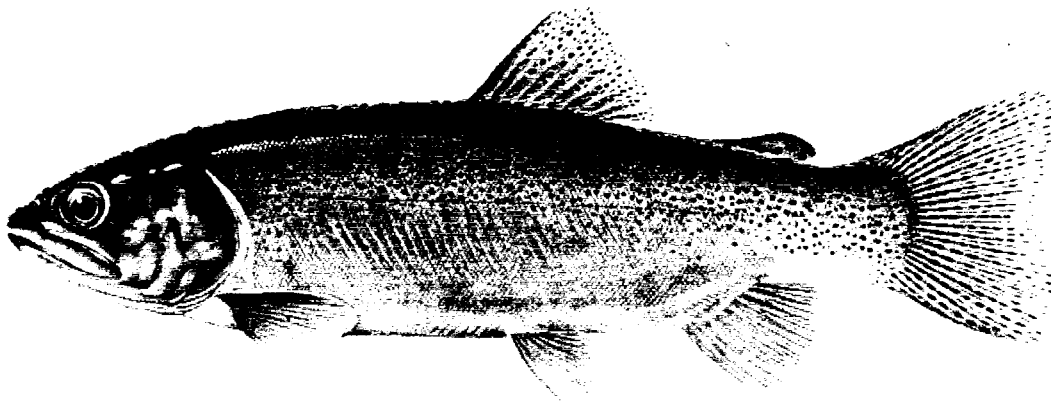


GILA TROUT RECOVERY PLAN



U.S. Fish and Wildlife Service
New Mexico Ecological Services State Office
Albuquerque, New Mexico
December 1993

GILA TROUT

(Second Revision)

RECOVERY PLAN

(Original Approved: June 20, 1983)

(First Revision Approved: January 3, 1984)

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8 December 1993

DISCLAIMER

Recovery **plans** delineate reasonable actions that **are** believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service and, sometimes, are prepared with the assistance of recovery teams, contractors, state agencies, and others. Objectives may be attained and any necessary funds may be made available subject to budgetary and other constraints affecting the parties involved as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or the Director. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery **tasks**.

Literature Citations should read as follows:

U.S. Fish and Wildlife Service. 1993. **Gila** Trout Recovery Plan. Albuquerque, New Mexico. 113 pages.

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The fee for the plan **varies** depending on the number of pages of the plan.

ACKNOWLEDGEMENTS

This Gila Trout Recovery Plan was prepared with the assistance of the Gila Trout/Chihuahua Chub Recovery Team, which is comprised of the following individuals:

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Numerous other persons provided reviews and/or information for the preparation of the plan. The U.S. Fish and Wildlife Service greatly appreciates the invaluable assistance provided by the team members, consultants, and other individuals who contributed to the preparation of this document.

The U.S. Fish and Wildlife Service also wishes to express its appreciation to the many individuals who have, over the years, assisted in recovery efforts for the Gila trout. Significant contributions were provided by Jerry Stefferud, John Kramer, Bill Britton, Jeff Whitney, Mark Whitney, Jerry Burton, Hugh Bishop, Nick Smith, Steve Harvill, Chris Pease, Russell Ward, and Dave Peters.

PREFACE

This revision of the Gila Trout Recovery Plan was developed under the direction of the Gila Trout and Chihuahua Chub Recovery Team, an independent group of biologists operating under the sponsorship of the U.S. Fish and Wildlife Service. The objective of this plan is to improve the status of the Gila trout, Cncorhynchus aila (Miller), to the point that its survival as a species is secure. Achievement of this objective includes protection and management of each extant population of this species and establishment of additional populations in order to maintain maximum genetic diversity.

This plan is divided into two general parts. The introduction describes the Gila trout, its historic and present distribution, reasons for its decline, and information on its biology and ecology. The step-down outline and narrative provide management procedures for protecting the species and for expanding the range and abundance of Gila trout to the extent that no natural or human-caused disturbance will result in irrevocable losses.

This plan may be used by agencies working with Gila trout to plan and coordinate management activities. As the plan is implemented, it may be revised as necessary. Plan implementation is the task of the management agencies (especially the New Mexico Department of Game and Fish, U.S. Forest Service, and U.S. Fish and Wildlife Service). Sound management of the resource and close coordination between management agencies should result in an increase in numbers and populations of Gila trout.

The Gila Trout Recovery Plan was approved by the U.S. Fish and Wildlife Service in June 1978, with revisions in June 1983 and January 1984.

EXECUTIVE SUMMARY

CURRENT SPECIES STATUS: The **Gila** trout is native to streams of the **Mogollon** Plateau of New Mexico and Arizona. In 1960, it was limited to five small populations in the upper **Gila** River system. Each population has since been replicated with **varied** success. The 1992 wild population was **<10,000** fish.

HABITAT REQUIREMENTS AND LIMITING FACTORS: The **Gila** trout is a typical cold water species. High water quality and stream cover are required to sustain the species. Major threats include habitat degradation and competition/hybridization with introduced trout.

RECOVERY OBJECTIVE: Near **term**, downlist; ultimately, delist. During the next 7 years, emphasis will be placed on securing existing populations and ensuring replicate **stocks** are adequately protected to ensure continued survival of the species.

RECOVERY CRITERIA: The five stocks that remain (1960 populations) may represent five separate "gene pools". These stocks **must be** retained and enhanced if the species is to **be** recovered and ultimately be an integral part of the Mogollon Plateau fish fauna. Because of threats from natural disasters (floods, droughts, and fires) and competition/predation and/or hybridization with/from introduced non-native salmonids, replication and security of wild populations is essential for recovery.

ACTIONS NEEDED TO DOWNLIST:

1. Maintain, protect, and monitor all populations.
2. Identify streams where the species can be reestablished.
3. **Remove** non-native trout and establish **Gila** trout into reclaimed streams.
4. Monitor grazing impacts upon existing and established populations.
5. Provide refugia and culture **Gila** trout needed for reestablishment.
6. Identify and maintain existing genotypes.

COSTS (\$000) :

Year	Action 1	Action 2	Action 3	Action 4	Action 5	Action 6	Total
1993	14.0	2.0	20.0	10.0	40.0	11.0	97.0
1994	14.0	2.0	20.0	5.0	40.0	10.0	91.0
1995	14.0	1.0	20.0	5.0	40.0	10.0	90.0
1996	15.0	2.0	25.0	5.0	50.0	7.0	104.0
1997	15.0	2.0	25.0	5.0	50.0	5.0	102.0
1998	15.0	1.0	25.0	5.0	50.0	2.0	98.0
1999	16.0	2.0	30.0	7.0	60.0	2.0	117.0
2000	16.0	2.0	30.0	7.0	60.0	2.0	117.0
Total Cost	119.0	14.0	195.0	49.0	390.0	49.0	816.0

DATE OF RECOVERY: If continuous progress is made, downlisting may be possible by the year 2000.

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PART1

INTRODUCTION

GOAL AND STRATEGY

Goal of the Plan

The goal of the Gila Trout Recovery Plan is to improve the status of Gila trout, Oncorhynchus gilae (Miller), to the point that survival of all indigenous lineages is secured and maintained. To accomplish this goal, a large array of factors was considered, including historical distribution of the species, its current status, information on the biology and ecology of the species, its habitat requirements and preferences, and available management alternatives. Consideration of these and other factors will allow determination of future courses of action that are biologically sound and operationally achievable. If recovery efforts are successful, downlisting may be expected. Delisting criteria have not been determined.

The goal of the Gila Trout Recovery Plan is compatible with authorities of the Endangered Species Act of 1973, Wilderness Act of 1964, New Mexico Wildlife Conservation Act of 1974, and Gila National Forest Plan. The three cited laws mandate protection, preservation, and recovery of endangered species and support the goal and intent of this plan.

Progress to Date

Recovery efforts to date for Gila trout have included replication of the five relictual populations, completion of several biology and ecology studies, initiation of development of hatchery rearing techniques, and development of a population monitoring protocol. Survey efforts are continuing in an attempt to locate new populations, and studies are being conducted to establish the degree of genetic divergence among the five indigenous populations and related salmonids. Efforts to inform the public concerning the plight of the Gila trout and to recover it have included production of brochures, development of a slide series and a video tape, and publication of several popular articles.

Strategy

Two basic strategies are available to meet the goal of this plan. One involves the preservation of Gila trout as a relictual species in a few small, isolated headwater streams without expanding its distribution within historic range to any appreciable degree. Use of this strategy would not decrease the likelihood of local extinction by natural events (e.g., drought, flood, fire) that may have a profound effect upon small headwater habitats. Implementation of this strategy would require evacuations, temporary holding measures, transplants, and extensive habitat manipulation to maintain the species in the highly variable, widely fluctuating headwater environments where it occurs.

A second, preferred, strategy is to accelerate expansion of current distribution of Gila trout within its historic range into larger, more stable, resilient habitats. Adoption of this strategy would greatly reduce the likelihood of local extinction caused by natural, stochastic events and human-induced disturbances. A benefit of this strategy would be establishment

of a unique, native trout sport fishery after the species is downlisted. Implementation of this strategy, despite difficulties involved with altering existing trout fisheries and managing the species in wilderness areas, could ensure long-term security of the **Gila** trout.

DESCRIPTION AND TAXONOMY

Description

In comparison to other western North American trout, native trout of southwestern North America have only recently been described. The **Gila** trout was described in 1950 by Miller from fish collected in Main Diamond Creek in 1939 (Miller 1950).

The following description of **Gila** trout is based on a composite of descriptions by R. David (U.S. Fish and Wildlife Service [USFWS], pers. comm. 1991), Miller (1950), Behnke (1973), and Beamish and Miller (1977).

Gila trout is readily identified by its iridescent gold sides, blending to a darker shade of copper on the opercle. Spots are **small** and profuse, sometimes approaching densities of **30/cm²**. Spots are generally confined to the area above the lateral line and extend onto the head and dorsal and caudal fin. Spots are irregularly shaped on the sides and increase in size as they progress dorsally. Those on the dorsal surface may be as large as the pupil of the eye and exhibit a rounded shape. A few **scattered** spots are sometimes present on the anal fin, and the adipose fin is typically large and well-spotted. Dorsal, pelvic, and anal fin have a white to yellowish tip that may extend along the leading edge of the **pelvics** in some specimens. A faint, salmon-pink band is present on adults, particularly during spawning season when the normally white belly may be streaked with yellow or reddish orange. A yellow "cutthroat" mark is present on most mature specimens. Parr marks are commonly retained by adults, although they may be faint or absent on some specimens. Baeibranchial teeth are known from specimens from Spruce Creek (tributary to the **San** Francisco River) and Oak Creek (an **extinct** population from the Verde River drainage). The species has a diploid chromosome complement of **2n=56**, consisting of 49 metacentric and eubmetacentric chromosomes, 7 acrocentric or telocentric chromosomes, and 105 arms. The range in means of several **morphometric** measurements and meristic counts have been reported to be significant diagnostic characteristics for **Gila** trout (Table 1).

Taxonomy

The genus **Oncorhynchus** is comprised of the Pacific salmon and trout. The generic name of the Pacific **trouts** was changed from **Salmo** to **Oncorhynchus** to reflect common evolutionary lineage of Pacific salmon and **trouts** as distinct from Atlantic salmon, **Salmo salar**, and **trouts** (Smith and Stearley 1989). **Systematics** of the genus **Oncorhynchus** are not well-defined. Current diversity and distribution of western **trouts** are mainly the result of division and subsequent isolation of populations during recent glacial epochs, about 25,000 to 50,000 years ago (Behnke 1979).

Table 1. Range in means of ten taxonomic characteristics from five Gila trout populations. Data represent a composite of information from: Behnke (1970, 1973, unpub. data), David (1976), Miller (1950), Needham and Gard (1959), Regan (1964), and Mello and Turner (1980). Sample size and fish size were variable and are thus omitted from the table. Data are presented only to give a general overview.

<u>Population</u>	Expressed as thousandths of Standard Length				<u>Vertebrae count</u>	Scales Above lateral line	Scales in Lateral series	<u>Pyloric caeca</u>	spots <u>per cm²</u>	<u>Basi- branchial teeth</u>
	<u>Head length</u>	<u>Upper jaw length</u>	<u>Pre- dorsal length</u>	<u>Adipose fin length</u>						
Main Diamond	293.0- 313.3	157.0- 178.0	521.0- 545.7	110.0- 122.0	60.2- 60.7	29.0- 31.8	141.2- 149.4	32.0- 34.9	22.2	Absent
south Diamond	300.5	173.1	549.0	108.0	60.8	32.8	150.1	33.8	31.0	Absent
ω McKenna	301.6- 312.0	172.2- 176.8	525.0- 533.4	102.5- 105.2	60.4- 61.7	29.5.. 31.8	147.0- 150.7	33.0- 34.4	11.4- 22.1	Absent
Upper Iron	298.0- 308.0	165.5- 175.0	515.0- 523.3	110.0- 123.7	60.9	31.1- 34.5	152.0- 152.5	31.4- 34.7	25.8	Absent
Spruce	292.0- 310.4	178.3	482.0- 523.3	123.7	59.3- 59.7	34.3- 34.4	154.4- 155.1	47.2- 48.2	11.9	Present

The Gila trout is more closely related to Apache trout, *O. apache*, and rainbow trout, *O. mykiss*, than it is to cutthroat trouts, *O. clarki* (David 1976, Beamish and Miller 1977, Loudenslager and Gall 1981, Loudenslager et al. 1986, B. Riddle, University of Nevada - Las Vegas, pers. comm. 1991).

Miller (1950) proposed that extant trouts represented rainbow and cutthroat trout lineages and that Gila trout was derived from the rainbow lineage. In other studies that supported this interpretation, rainbow trout is believed to be derived from an ancient form that also includes Gila trout (Needham and Gard 1959, Loudenslager and Gall 1981, Loudenslager et al. 1986). Another interpretation concludes that extant trouts represented rainbow/redband (*O. newberryi*), cutthroat, and golden trout (*O. aquabonita*) lineages (Behnke 1970, Schreck and Behnke 1971, Legendre et al. 1972, Gold 1977, Behnke 1979).

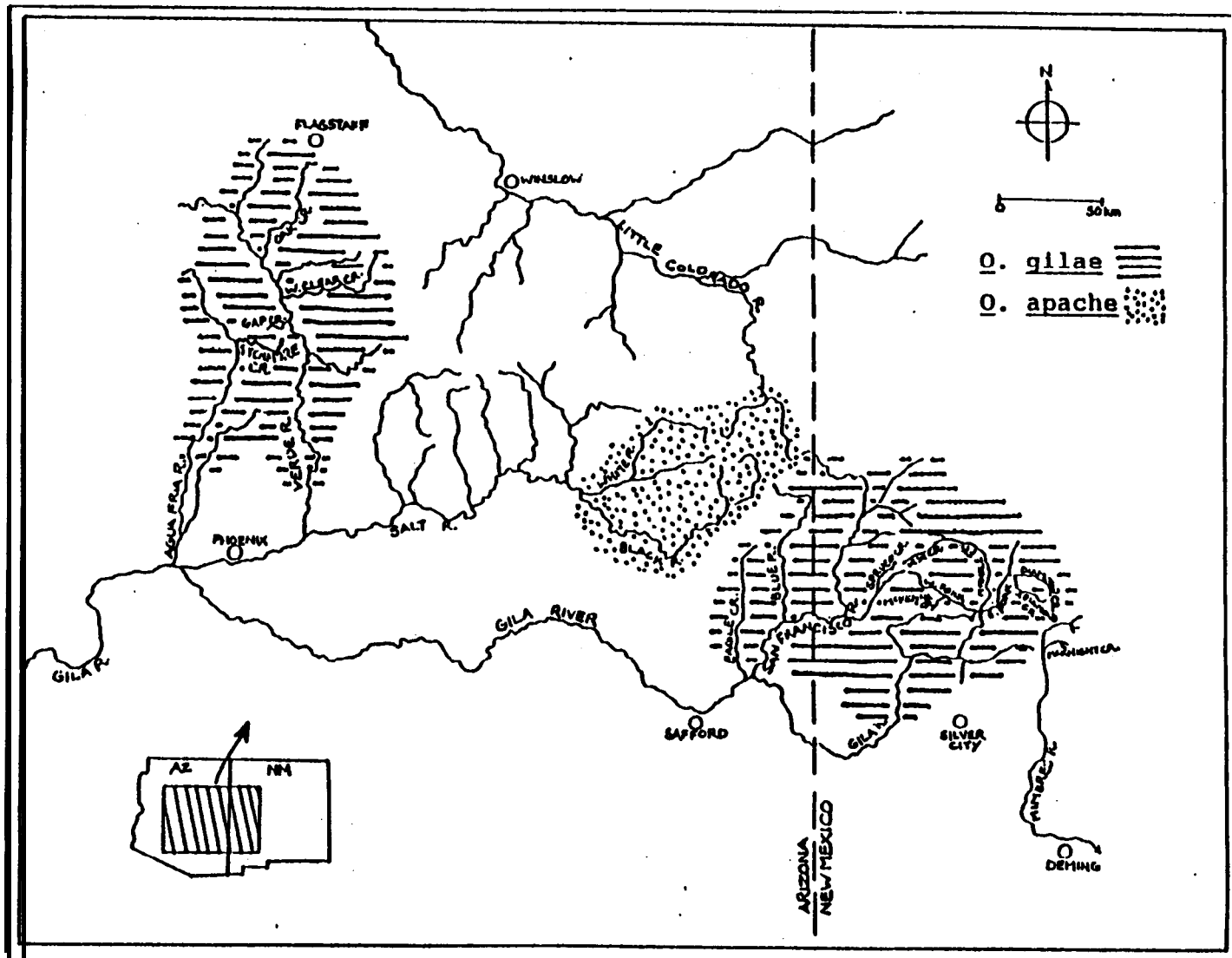
The golden trout lineage was composed of relict forms with disjunct distributions and included Gila trout. This group was considered to have evolved from a common ancestor originating in the lower Colorado River drainage. Miller (1972) proposed that the golden trout complex was polyphyletic and represented two or three lineages, one being Gila trout.

After the Gila trout was described, additional naturally occurring populations were discovered in South Diamond, Iron, McKenna, and Spruce creeks (Behnke 1970, Hanson 1971, David 1976). These populations of Gila trout are located in small headwater streams and have survived because they have been isolated by natural barriers such as stretches of dry stream or impassable waterfalls. This isolation has resulted in genetic and morphologic variation among these populations (Behnke 1970, David 1976, Loudenslager et al. 1984, B. Riddle, pers. comm. 1991). This variation may also be the result of isolation between Gila trout populations in drainages of the Gila River system for several thousand years (Behnke 1970). David (1976) proposed three forms of Gila trout: the East Fork Gila River drainage form consisting of the Main and South Diamond creeks populations, the West/Middle Fork Gila River drainage form consisting of the Iron and McKenna creeks populations, and the San Francisco River drainage form consisting of the Spruce Creek population.

HISTORIC DISTRIBUTION

Gila trout was historically the only native trout in the headwaters of the Gila River drainage, New Mexico (Figure 1). The unique characteristics of Gila trout in Spruce Creek suggest it was also native to the San Francisco drainage in New Mexico. Possible historic occurrence of Gila trout in the San Francisco drainage in Arizona is indicated by reports of the species in the Eagle Creek drainage (Figure 1) (Minckley 1973). Gila trout reportedly once occurred in the Verde and Agua Fria drainages in Arizona as well (Behnke and Zarn 1976).

Figure 1. Probable historic distribution of Gila trout (*Oncorhynchus gilae*), and Apache trout (*O. apache*) (from Behnke & Zarn, 1976).



Gila River Drainage, New Mexico

Historically, **Gila** trout probably inhabited the **Gila** River and most of its tributaries upstream from the confluence of Mogollon Creek and the **Gila** River. Miller (1950) related interviews F. A. Thompson (New Mexico Department of Game and Fish) had with "old-timers" concerning the distribution of **Gila** trout:

In 1896 Salmo gilae ranged as far down the **Gila** River as the mouth of the box canyon, which is about 7 miles northeast of Cliff . . . 'Speckled trout' were once so abundant in Gillita [sic] and Willow creeks (tributaries to the Middle Fork of the **Gila**) that it was possible to catch them at the rate of about 1 a minute. The usual weight of these fish varied from one-half to 1 pound and they averaged about 12 inches in length Native trout fishing was good on South Diamond Creek and Black Canyon . . . but on certain parts of 'Mogollon Creek, particularly the West Fork . . . there was an overpopulation of native trout and these fish were dwarfed. The largest fish caught by one 'old-timer' in the early days weighed 2 pounds and was taken at the junction of the Middle and West Forks of the **Gila**, just west of the **Gila** Cliff Dwellings National Monument. In 1898 the **Gila** trout was found in all of the **Gila** headwaters and was generally referred to as 'mountain trout' In 1915 trout were caught as far down the **Gila** as the mouth of Sapillo Creek At the present time the water is generally too warm in that section of the **Gila** River for any species of trout.

Allegedly, **Gila** trout originally was absent from Mogollon Creek until 1915 when John Hightower translocated the species from West Fork **Gila** River into West Fork Mogollon Creek (P. R. Turner, New Mexico State University, fide B. Rice, *pets. comm.* 1991).

San Francisco Drainage

Miller (1950) recounted testimony that the San Francisco River was originally devoid of trout and **Gila** trout was introduced into tributaries of the San Francisco River in 1905. Big Dry Creek was reported to be one of the streams stocked in 1905. However, the population of **Gila** trout in Spruce Creek, a tributary of Big Dry Creek, is isolated from Big Dry Creek by two impassable falls. A native trout species also inhabited the Blue River drainage, which is tributary to the San Francisco River. No physical barriers are known to exist that would have prevented trout from migrating up into the San Francisco River drainage from the Blue River drainage (Behnke 1970).

The putative historical occurrence of **Gila** trout in the San Francisco River drainage is supported by the presence of a pure population of **Gila** trout in Spruce Creek, a San Francisco River tributary. Behnke and Zarn (1976) have speculated that the differences between the population in Spruce Creek and others ". . . might be construed as evidence supporting the indigenous occurrence of S. gilae in the San Francisco drainage." Native trout reportedly occurred in Eagle Creek, the next major drainage west of the San Francisco drainage (Mulch and Gamble 1956). Although this native could have

been Apache or Gila trout, Minckley (1973) noted that the native chub Gila robusta arahami, which is found in Eagle Creek, apparently had a similar historic distribution to Gila trout in the Gila River drainage. Trout collected in 1973 from Chitty Creek, a tributary of Eagle Creek, were tentatively identified by W. L. Minckley and confirmed by R. R. Miller as Gila x rainbow trout hybrids (R. R. Miller, University of Michigan Museum of Zoology, pers. comm. 1991). Mitochondrial DNA analysis revealed the Spruce Creek population could be differentiated from other pure populations, which also indicates that it may be native to the San Francisco River drainage (B. Riddle, pers. comm. 1991).

Verde and Agua Fria Drainages, Arizona

Miller (1972) confirmed the historic occurrence of Gila trout in the Verde drainage. Trout collected in 1888-89 from Oak Creek, a tributary to the Verde, were identified as Gila trout. Also, life color description of trout collected from West Clear Creek, another tributary of the Verde, corresponded with Gila trout. Trout collected in 1975 from Sycamore Creek, a tributary of the Agua Fria, were reported to be Gila x rainbow trout hybrids based on examination of spotting pattern (Behnke and Zarn 1976).

PRESENT DISTRIBUTION

The range of Gila trout had been severely fragmented into small, isolated headwater streams when it was described by Miller in 1950 (Sublette et al. 1990, Propst et al. 1992). Since 1950, the range has been expanded by translocating Gila trout into renovated or barren streams (Figure 2).

Relictual Populations

Five small headwater streams (Main Diamond, South Diamond, McKenna, Spruce, and Iron creeks) supported the five surviving relictual populations. In 1989, a forest fire and associated watershed destabilization eliminated the Main Diamond population and recent genetic analysis of the McKenna population indicates it has been contaminated by rainbow trout (B. Riddle, University of Nevada - Las Vegas, pers. comm. 1991).

Translocated Populations

Individuals of each of the five relictual populations of Gila trout have been translocated into other streams. The Main Diamond Creek lineage has been translocated into McKnight, Sheep Corral, and Gap creeks. The South Diamond Creek lineage has been translocated into upper Mogollon Creek and Trail Canyon, the McKenna Creek lineage into Little Creek, the Iron Creek lineage into Sacaton Creek, and Spruce Creek lineage into Big Dry Creek. All reintroduced populations are within the presumed historic range of Gila trout except the McKnight Creek population, which is in the Mimbres River drainage and outside the presumed native range of Gila trout.

Hybrid Populations

Tributaries of the Gila River that contained Gila x rainbow trout populations are Black, Sycamore, Langstroth, Miller Spring and Trail Canyons, and upper Mogollon, upper Turkey, and West Fork Mogollon creeks (David 1976, B. Riddle, pers. comm. 1991). Tributaries of the San Francisco River that contain hybrid populations are Whitewater, Big Dry, and Mineral creeks, and Lipsey Canyon. The influence of Apache or cutthroat trout appears in hybrid populations of the San Francisco River drainage (David 1976).

REASONS FOR DECLINE

Declines in abundance of Gila trout in New Mexico have been associated with competition among and hybridization with non-native salmonids, and changes in stream conditions (Miller 1950). Miller (1961) reported dramatic changes in native fish faunas and aquatic habitats in the Southwest and cited destruction of vegetation and resulting erosion, sedimentation, and lowering of water tables as the greatest impact on aquatic environments:

The aboriginal habitats have become modified in various ways. There has been a shift from clear, dependable streams to those of intermittent flow subject to flash floods that carry heavy loads of silt. As a result of loss in volume and destruction of vegetation, there has been a trend towards rising temperatures in the surviving waters. The smaller creeks, springs, marshes, and lagoons have disappeared, due in part to severe lowering of the water table. There has been destruction of trees, grasses, and aquatic plants; pollution from industrial and domestic wastes; deep channeling (arroyo cutting) of stream beds; and gully erosion on bare hillsides.

Behnke and Zarn (1976) cited stocking of rainbow and cutthroat trout throughout the western United States and resulting hybridization with indigenous trouts as the primary reason for the decline of native trouts.

CONSERVATION EFFORTS AND CURRENT STATUS

Initial efforts to protect Gila trout were made by the New Mexico Department of Game and Fish (NMDGF) years before the species was described. Jenks Cabin Hatchery, near the confluence of White Creek and West Fork Gila River, was built in 1923 to propagate Gila trout. Limited success, coupled with difficult access, resulted in its closure in 1935. Further attempts at propagating Gila trout in hatcheries were unsuccessful and such efforts were discontinued by NMDGF in 1947. Since then, NMDGF has followed a policy of not stocking non-native trout into the few tributaries where Gila trout was known to persevere.

Investigation of Gila trout originally came at the request of Elliot S. Barker, State Game Warden of New Mexico, and led to the description of the species from specimens taken at Glenwood Hatchery and Main Diamond Creek in 1939 (Miller 1950). The NMDGF closed Main Diamond Creek to fishing in 1958 (Hanson 1971) and sponsored an ecological study of Gila trout in Main Diamond

Creek during 1962-63 to provide basic information for future management of the species (Regan 1964).

In 1966, **Gila** trout was listed as endangered in the USFWS "Red Book." Protection was given to **Gila** trout under the Federal Endangered Species Preservation Act of 1966 (80 Stat. 926). A management plan for **Gila** trout was approved by the **Gila** National Forest and NMDGF in 1972 (Bickle 1973). The Endangered Species Act of 1973 provided protection to all species of wildlife that had been designated as endangered under the Endangered Species Preservation Act of 1966 (USFWS 1975).

During 1974-76, stream surveys were conducted that established the current distribution and status of **Gila** trout (David 1976, Mello and Turner 1980).

In 1979, the **Gila** Trout Recovery Plan was approved by USFWS with the main objective being "To improve the status of **Gila** trout to the point that its survival is secured and viable populations of all morphotypes are maintained in the wild." (USFWS 1979). -An environmental assessment for **Gila** trout recovery projects on the **Gila** National Forest was approved that directed the stabilization and replication of indigenous populations of **Gila** trout involving both artificial barrier construction and piscicide application in streams within the **Gila** Wilderness (U.S. Forest Service [USFS] 1979).

The **Gila** Trout Recovery Plan was revised in 1984 with the same objective. Downlisting criteria were **recommended** as follows;

The species could be considered for downlisting from its present endangered status to a threatened status when survival of the five original ancestral populations is secured and when all morphotypes are successfully replicated **or** their status otherwise appreciably improved (USFWS 1984).

A mitochondrial DNA and electrophoretic study of all known **Gila** trout populations, suspected **Gila** trout populations, and related species was initiated in January 1988. Tissue samples for this project were collected during the summers of 1988 and 1989. Additional samples were collected in 1990 and 1991 (D. L. Propst, NMDGF, pers. comm. 1991). Following are chronological accounts of **Gila** trout recovery activities that have occurred on relictual and translocated populations:

Main Diamond

In the 1930's, the Civilian Conservation Corps constructed log stream improvement structures in many streams in the **Gila** National Forest, including Main Diamond Creek. During 1965-66, the **Gila** National Forest and NMDGF repaired 108 of these structures and constructed 11 new structures.

Prior to 1989, Main Diamond Creek was considered to be the most stable, secure population of **Gila** trout (USFWS 1984); however, a series of events in 1989 dramatically changed the status of the population. In July 1989, a large portion of the 24,762 ha Divide Fire burned in the Main Diamond Creek watershed. During the fire, 566 **Gila** trout were removed to Mescalero National

Fish Hatchery. Following the fire, hail and rainstorms washed large amounts of ash and sediment into the stream. Concentration of total suspended solids in the stream during runoff on 20 July 1989 was 181,452 mg/L (P. R. Turner, pers. comm. 1991). The increased surface runoff resulted in widely fluctuating flows that scoured channel banks and eliminated trout habitat. Main Diamond Creek was sampled extensively in October 1989 and again in May 1990; no Gila trout was found (D. L. Propst, pers. comm. 1991). The aquatic macroinvertebrate community was diminished to very low density and diversity after the fire. Repeated flooding and sedimentation since 1989 has reduced the aquatic macroinvertebrate community to below post-fire levels (G. Z. Jacobi, New Mexico Highlands University, pers. comm. 1991).

McKnight Creek

Flooding in August 1988 caused major reductions in pool habitat and over 90 percent loss of Gila trout in McKnight Creek (Turner 1989). In October 1989, 200 of the evacuated Gila trout from Main Diamond Creek were stocked into McKnight Creek. Stream-habitat structures were constructed and willow cuttings planted in McKnight Creek in 1989-1990 by the USFS and New Mexico State University.

Gila trout from Main Diamond Creek have been translocated into several streams in New Mexico and one stream in Arizona. A study conducted during 1969-1970 by Hanson resulted in selection of McKnight Creek in the Mimbres River drainage as a transplantation site for Main Diamond Gila trout (Hanson 1971). After construction of a barrier and elimination of the native Rio Grande sucker (Catostomus plebeius) with rotenone, 307 Gila trout were transplanted from Main Diamond Creek into McKnight in November 1970. Drought in 1971 reduced the population to less than 20. On April 27, 1972, 110 Gila trout from Main Diamond Creek were translocated into McKnight Creek to supplement the reduced population.

Sheeo Corral Canyon

In 1972, 89 Gila trout from Main Diamond Creek were transplanted into Sheep Corral Canyon in an attempt to establish a new population (Turner 1989).

Gap Creek

In 1974, 65 Gila trout from Main Diamond Creek were translocated into Gap Creek, a tributary of the Verde River in Prescott National Forest, Arizona (Minckley and Brooks 1985, Warnecke 1987). By 1981, the population was estimated to have expanded to approximately 150 fish; however, the population has recently dwindled to just a few fish and is no longer considered viable (J. A. Stefferud, USFS, pers. comm. 1991).

South Diamond Creek

During the summer of 1989, South Diamond Creek was dry from its mouth to above Burnt Canyon (R. Ward, USFS, pers. comm. 1991). South Diamond Creek was affected by the Divide Fire, that burned in the upper watershed of the stream. As a result of the fire, the area downstream of the confluence with Burnt

Canyon became scoured and filled with fine gravel that eroded from the burned slopes, rendering the reach uninhabitable by trout. However, a small population in the marginal habitat of Burnt Canyon survived the events and several Gila trout were found in the main channel of South Diamond Creek in May 1990 (D. L. Propst, pers. comm. 1991).

Trail Canyon

Upper Mogollon Creek and Trail Canyon were selected as sites for transplanting Gila trout from South Diamond Creek. Trail Canyon was treated with antimycin A in October 1986 to eradicate non-native trout. The stream was retreated in July 1987 to remove remaining non-native trout. In September 1987, Trail Canyon was found to be barren and 305 Gila trout were transported by helicopter from South Diamond Creek and stocked into Trail Canyon. In October 1988, fish from South Diamond were used to supplement the Trail Canyon population. Reproduction in Trail Canyon was confirmed in 1989 (Propst et al. 1992).

Upper Mogollon Creek

Mogollon Creek, from its source to the confluence with Trail Canyon, was initially treated with antimycin A to remove non-native trout in July 1987: Several non-native trout were found to have survived the initial treatment of upper Mogollon Creek and it was retreated in July 1988. At the same time, Woodrow Canyon, a renovated tributary of upper Mogollon Creek, was also stocked with Gila trout from South Diamond Creek. In April 1989, Gila trout brood stock were obtained from South Diamond Creek and taken to Mescalero National Fish Hatchery, and a third antimycin A treatment was made. Eradication of non-native trout in upper Mogollon Creek was confirmed in May 1989 and, in October 1989, the creek was stocked with 100 fingerling Gila trout from Mescalero National Fish Hatchery plus 93 Gila trout from Trail Canyon.

McKenna Creek

Recent mitochondrial DNA analysis indicated that the Gila trout population in McKenna Creek has been hybridized with rainbow trout. The high level of genic polymorphism indicates hybridization was of recent occurrence, perhaps since 1974 (B. Riddle, pers. comm. 1991). These findings render the status of the McKenna Creek population problematic.

Little Creek

Little Creek was selected as a restoration stream for Gila trout from McKenna Creek. In 1982, a concrete-masonry barrier was constructed in Little Creek and approximately 9 km of stream above the barrier was treated to remove non-native trout. Desert sucker (Catostomus clarki) was also eliminated; however, speckled dace (Rhinichthys osculus) survived the treatment. In December 1982, 100 Gila trout were successfully transported from McKenna Creek to Little Creek. These fish reproduced and the population increased through 1988 (P. R. Turner, pers. comm. 1991). Little Creek is susceptible to flooding and the translocated Gila trout population was diminished by flooding in August 1988.

Because recent mitochondrial DNA analysis indicated that the McKenna Creek Gila trout population has been hybridized with rainbow trout, and Gila trout from the McKenna Creek population were used to restock Little Creek in 1982, it is possible that the present population of Gila trout in Little Creek is not genetically pure.

Iron Creek

In 1981, a concrete-masonry barrier was constructed in Iron Creek about 2.9 km downstream from an intermittent stretch. Brown trout density was reduced with antimycin A between these barriers after Gila trout had been removed from the area by electrofishing and placed in holding pens isolated from the toxicant. Gila trout were prematurely released into the renovated area and suffered high mortality (Coman 1981). Surveys in 1982-83 indicated Gila trout survival was low and reproduction was limited. In 1984, 105 Gila trout were moved from the upper reach of Iron Creek downstream to the renovated area (Turner 1989). The population of Gila trout in Iron Creek is increasing in the renovated reach (Turner 1989). Brown trout were removed from the renovated reach in 1985 and 12 Age-2 brown trout were removed in 1988. No brown trout were found in 1990 in the lowest 800 m of occupied habitat (D. L. Propst, pers. comm. 1991).

Sacaton Creek

Gila trout (40 fish) from Iron Creek were stocked into barren Sacaton Creek in May 1990. A second stocking of 60 fish was made in June 1991.

Spruce and Big Dry Creeks

A 1.9-km reach of Big Dry Creek above a 20 m waterfall barrier was treated with antimycin A in 1984. This first treatment was not successful and another treatment was applied in 1985. In October 1985, 97 Gila trout were translocated from Spruce Creek to the renovated reach of Big Dry Creek.

The translocated population in Big Dry Creek was sampled in 1987 and no evidence of successful reproduction since the 1985 translocation was documented. However, fingerling Gila trout were found in 1990 (D. L. Propst, pers. comm. 1991).

Current Status

As a result of progress being made in recovery efforts, the Gila trout was proposed for downlisting from endangered to threatened status in 1987 (USFWS 1987). However, due to the continued presence of brown trout in Iron Creek, the hybridization of the McKenna Creek population, and the effects of drought, fire, and floods upon the Main Diamond, South Diamond, and McKnight populations, the proposal was withdrawn (G. Burton, USFWS, pers. comm. 1991).

From 1974-1984, Gila trout populations were relatively stable, with numbers of trout either remaining constant or increasing (Turner and McHenry 1985). An estimated 18,000-26,000 Gila trout occurred in the wild in 1985 (Table 2). An array of stochastic natural events during 1988-89 affected the fragile headwater habitats of several Gila trout streams and led to the drastic

Table 2. Estimated number of Age-1+ Gila trout in 1985, from Turner (1986a)

Stream	Number of age 1+ Gila trout, 1985	Length of inhabited reach (km)
Main Diamond	12,000-15,000	7
South Diamond	2,000-4,000	4
McKenna	350-500	1
Iron	750-1,300	5
Spruce	500-1,000	4
McKnight	2,000-3,500	13
Sheep Corral	50-100	1
Gap (Arizona) ^b	70-150	2
Little	500-750	6
Big Dry	97 ^a	2
Total	18,317-26,397	45

^a 200 Gila trout transplanted from Spruce Creek in October 1985.

^b From Warnecke (1987). Length of inhabited stream is from 1981 measurement, lower population estimate is from 1987 survey, and upper population estimate is from 1981 survey.

reduction in the Main Diamond, South Diamond, and McKnight populations of Gila trout (Propst et al. 1992). As of 1985, these three populations comprised over 80 percent of the known Gila trout (Table 2).

RESTORATION METHODS

Expansion of the current range of Gila trout is necessary to reduce the possibility of extinction (e.g., Wilcove et al. 1986, Quinn and Hastings 1987). This can be accomplished by translocating Gila trout into streams that are barren of trout or by renovating streams with non-native trout populations. Barren streams with currently perennial flow may have had local extinctions of resident fish populations in the past by flooding, low water, or other events. These streams may continue to be susceptible to these events and, thus, are of questionable long-term utility in recovering Gila trout. Streams with existing populations of non-native trout have a higher probability of maintaining self-sustaining populations of Gila trout.

~~Evaluation Criteria for Candidate Restoration Streams~~

Criteria for selection of candidate restoration streams were developed from the 1980 environmental assessment and 1988 Gila Trout Recovery Team meeting discussions. The criteria (not in priority order) are as follows.

<u>Selection Criteria</u>	<u>Evaluation Method</u>
1. Wilderness Stream	Yes/No
2. Restoration Stream Length	Perennial Kilometers
3. Same Watershed as Parent Stream	Yes/No
4. Aquatic Habitat Characteristics	Description
5. Natural Barrier Available	Yes/No
6. Artificial Barrier Sites Available	Yes/No
7. Barrier Construction Method	. Rock Masonry/Blasting/Other
8. Stream Habitat Improvement Needed	Yes/No
9. Brown/Brook Trout Eradication	Yes/No
10. Rainbow Trout Eradication	Yes/No
11. Other TES & Native Species Present	Yes/No
12. Stream Within Historic Range	Yes/No
13. Translocation by Pack Stock (PS) or Helicopter (H) or Both (B)	PS/H/B
14. Estimated Fishing Pressure	Angler Days
15. Closure to Sport Fishing Required	Yes/No
16. Percent of Total Coldwater Fishing Stream Kilometers (576 Total)	Percent
17. Public Access	None/Trail/Road
18. Estimated Implementation Costs	Dollars
19. Habitat Suitability for Gila Trout	High/Med/Low
20. Existing Trout Carrying Capacity	kg/ha, #/km
21. Stability of Watershed Relative to Flooding and Drought	High/Med/Low
22. Fire Susceptibility/Fuel Load	High/Med/Low

Toxicant Application

Use of toxicants is currently the most effective means to eliminate non-native salmonids from a restoration stream (Berger et al. 1969, Gilderhue et al. 1969, Rinne and Turner 1991). Piscicides available include sodium cyanide, chlorine, rotenone, and antimycin A. Of these, antimycin A is the most effective. Antimycin A is an antibiotic produced in Streptomyces cultures. It is lethal at the recommended concentration of 10 parts per billion and is easily detoxified with a 1.0 part per million concentration of potassium permanganate, which is harmless in the environment. Fish killed by antimycin A do not pose a health hazard to man or wildlife, but, as a precaution, a 1-week restriction period is recommended. Antimycin A is more effective than rotenone because it does not repel fish. Because of the low dosages required and the properties of the piscicide, antimycin A is also easier to transport to remote sites than rotenone. Antimycin A works well in both cool and warm waters and in the presence of aquatic plants. It has no mammalian toxicity and has less effect than rotenone on phytoplankton, zooplankton, amphibians, and aquatic macroinvertebrates when applied in recommended dosages, although it does cause mortality of amphibians (Berger 1965, Walker et al. 1964, Herr et al. 1967). When Big Dry Creek was treated with antimycin A in 1985, there was a minimal, short-term effect on the macroinvertebrate community, but no long-term effect was documented (Mangum 1985).

Barrier Construction

Renovated reaches of stream must be protected from upstream migration of non-native trout, preferably by locating suitable restoration areas with existing natural barriers to upstream movement, as was done in Big Dry, upper Mogollon, and Sacaton creeks and Trail Canyon. However, the number of stream reaches suitable for Gila trout translocation that have existing natural barriers is limited. Therefore, when a suitable restoration stream with no barriers is identified, the construction of a barrier is warranted. Barrier design is tailored to the conditions at the site. For example, waterfalls often can be modified by hand drilling and blasting to create an impassable barrier, or a barrier may be created by construction of a log crib. Another method is construction of a rock and masonry barrier, consisting of cementing rocks and boulders together to form an artificial barrier, as has been done at McKnight, Iron, and Little creeks. The visual effect of this type of barrier is minimal.

Captive Propagation

As part of a program to develop a Gila trout broodstock, 1,686 eggs were obtained from the McKnight Creek population in April 1988 and were transported to Mescalero National Fish Hatchery. In addition, 40 Gila trout were collected from Main Diamond Creek and transported to the Hatchery for inclusion in the broodstock program. Ten of these fish produced 1,047 eggs, of which 42 percent hatched. By October 1988, the 794 Gila trout fingerlings produced averaged 2 inches in length (USFWS 1988). In 1974, production of Gila trout fingerlings was accomplished at Sterling Springs Hatchery in

Arizona, but the fish died before they could be stocked (B. Silvey, Arizona Game and Fish Department, pers. comm. 1991)

Fish Transportation

Methods used to transport **Gila** trout from one site to another depend upon conditions. The key element in deciding which method to employ is assuring survival of fish during transport. Two common transport methods used are pack stock and helicopter. When pack stock are employed, **Gila** trout are placed in plastic-lined panniers partially filled with water, oxygenated and possibly iced-down, and transported to the restoration stream. Helicopter transport involves use of a specially designed transport tank. This tank was used in the translocation of **Gila** trout from **McKenna** to Little Creek, South Diamond to Trail Canyon, and South Diamond to upper Mogollon Creek.

PUBLIC INFORMATION AND EDUCATION

Education and dissemination of information on **Gila** trout are integral parts of the recovery effort. One aspect of this program is heightening public awareness of **Gila** trout as a component of the native fauna. Another aspect is the role of threatened and endangered species recovery in maintaining biological diversity. Information on **Gila** trout recovery will help to dispel misconceptions that may result in unfounded objections being raised when a stream is proposed for renovation to stock **Gila** trout.

Efforts to inform the public on **Gila** trout recovery have increased in past years. Recovery efforts have been presented to the public through television, and popular articles have been published in newspapers and magazines, notably New Mexico Wildlife. A brochure was developed by the Recovery Team that describes the recovery program, and a videotape is being developed by **NMDGF** that describes recovery of the **Gila** trout (S. Brown, **NMDGF**, pers. comm. 1991). The Arizona-New Mexico Chapter of the American Fisheries Society developed a videotape, "Endangered Fish of the Southwest: The Upstream Struggle," which includes coverage of **Gila** trout. Individuals involved in **Gila** trout recovery have presented slide shows, poster displays, and talks to the public concerning recovery of **Gila** trout.

ECOLOGY OF **GILA** TROUT

Discussion of the life history and ecology of any native western North American **salmonid** must be tempered with the realization that habitat characteristics, growth, and fecundity are not narrow and well-defined among these species. Trout are opportunistic feeders. Growth depends not only on food supply, but also on **inter-** and **intraspecific** competition, water temperature, length of growing season, and physical habitat characteristics. Fecundity is dependent upon body size and condition (Behnke and Zarn 1976, Behnke 1979).

Habitat Characteristics

Gila trout habitat currently consists of small headwater streams with limited pool availability and generally low base flows. Occupied habitats range in elevation from about 2,810 m in Iron Creek to about 1,660 m in Sheep Corral Canyon (Table 3). Gradient is generally high, although it ranges from 13.5 percent in Big Dry Creek to 2.3 percent in South Diamond Creek. Substrate composition in Gila trout streams varies with discharge and gradient. In general, siltation is low and cobble is the predominant substrate. Pool area relative to riffle area is variable among streams. Log stream improvement structures have been constructed in Main Diamond, South Diamond, and McKnight creeks and Sheep Corral Canyon in an effort to improve trout habitat by increasing the amount of pool habitat (Rinne 1981).

Streams containing populations' of Gila trout encompass two riparian vegetative communities (Brown 1982). The arctic-boreal riparian community occurs within subalpine forest (ca. 2,450-3,500 m elevation) and extends to lower elevations in cool microclimates. Shrub willows (e.g., Salix monticola, S. scouleriana, S. bebbiana, S. irrorata) commonly form thickets along streams. Other deciduous shrubs such as red elderberry (Sambucus racemosa), goose-berry currant (Ribes spp.), raspberry (Rubus spp.), and thin-leaf alder (Alnus tenuifolia) are also common. Tree species of the subalpine conifer forest such as Engelmann spruce (Picea engelmannii), blue spruce (P. pynaens), subalpine fir (Abies lasiocarpa), and aspen (Populus tremuloides) are often present. The cold-temperate riparian community (ca. 1,700-2,300 m elevation) is the predominant type along streams currently occupied by Gila trout. Major components of this community are narrowleaf cottonwood (P. annuustifolia), box elder (Acer neaundo), alder (A. oblonaifolia), and willows. Montane woodland and conifer forest species such as white fir (A. concolor), aspen, ponderosa pine (Pinus ponderosa), Gambel oak (Quercus gambelii), New Mexico locust (Robinia neomexicana), and smooth sumac (Rhus glabra) often occur. Shrub growth of willows and other species such as red-osier dogwood (Cornus stolonifera) and thin-leaf alder is frequently a dominant aspect. Canopy cover in streams containing Gila trout ranges from 11-65 percent (Table 3).

No long-term, seasonal stream discharge data are available for any streams containing populations of Gila trout. Flows are generally low, but fluctuate with precipitation events and trends. In a study conducted at Main Diamond, South Diamond, and McKnight creeks during 1977-78, modal flows ranged between 0.5-5.8 liters/sec with flows increasing 30-50 times (Rinne 1980). Floods in the southwestern United States typically are of high magnitude and short duration.

Detailed water chemistry analyses have been conducted on Main Diamond and McKnight creeks (Table 4) (Hanson 1971). All parameters tested were within the tolerance range of salmonids and none would be expected to cause stress or disease of fish (Thurston et al. 1979).

In currently occupied streams, Gila trout is the only fish species present, except in Little Creek where speckled dace (Rhinichthys osculus) also occurs. Prior to renovation, there were Rio Grande sucker in McKnight Creek, desert

Table 3. Physical habitat characteristics of streams with Gila trout populations.

<u>Stream</u>	<u>Elevation Range Upper Lower (m)^b</u>	<u>Pool: Riffle Ratio^b</u>	<u>Watershed Area (ha)^b</u>	<u>Percent s-l-o-w</u>	<u>Cover (%)^a</u>	<u>Mean Width (m)^a</u>
Main Diamond	<u>2675</u> <u>2320</u>	54:46	1788	3.7	29-37	2.8-3.2
south Diamond	<u>2500</u> <u>2365</u>	25:75	2307	2.3	46-65	2.0-2.6
McKenna Creek	<u>2110</u> <u>2015</u>	30:70	1270	9.6	11	2.5
Iron Creek	<u>2810</u> <u>2675</u>	55:45 ^d	3577 ^e	4.5	12-18	1.7-2.5
Spruce Creek	<u>2500</u> <u>2055</u>	55:45	726	10.0	26	3.2
McKnight Creek	<u>2510</u> <u>2100</u>	5:95	1374	3.9	12-26	1.9-2.5
Sheep Corral	<u>1740</u> <u>1660</u>	40:60	804			
Little Creek	<u>1960^f</u> <u>1850</u>	36:64 ^d			—	
Big Dry Creek	<u>2555</u> <u>2400</u>	39:61 ^d	607	13.5	32-42	2.6-3.3
Trail Canyon ^g	<u>2121</u> <u>2036</u>	—	918	6.6	—	—
Upper Mogollon ^g	<u>2255</u> <u>2036</u>	—	2663	5.2	—	—
Sacaton ^g	<u>2279</u> <u>2084</u>		124	8.6	—	—

Table 4. Water chemistry parameters from Main Diamond and McKnight creeks, 1970.

Parameter	Main Diamond*	McKnight*
Dissolved Oxygen	10.0	
Free CO ₂	<5.0	
Alkalinity		
Hydroxide	0	0
Carbonate	0	0
Bicarbonate	34.5	54.0
Total Hardness	39.7	50.0
Nitrogen		
Ammonium	0.28	0.40
Nitrite	0.001	0
Nitrate	0.067	0
Phosphate		
Total	0.33	4.9
Ortho	0.12	2.5
Poly (Meta)	0.21	2.4
Sulfate	11.17	9.0
Turbidity	2.4	
pH ^b	7.0	7.6
Total Dissolved Solids (as NaCl)	trace	trace
Aluminum	0.09	0.20
Barium	10.0	7.0
Boron	0	
Bromine	0	0
Chloride	3.3	
Chlorine	trace	
Chromate .	0.09	
Color (Apparent) ^c	11.4	
Copper	0.20	0.15
cyanide	0.01	
Detergents	0.06	0
Flouride	0.52	1.11
Hydrazine	0.01	
Iron	0.07	0
Manganese	0.30	
Selenium		0
Silica	36.0	28.0
Silver	trace	trace
Tannin & Lignin	0.18	

* Unweighted means from Hanson (1971).

^b Negative log of the hydrogen ion concentration,

^c Platinum cobalt units on the Ford-Ule scale.

sucker in Little Creek, and speckled dace in Hogollon Creek. Brown trout still inhabit the renovated portion of Iron Creek.

Streams containing Gila trout have a typical array of aquatic macroinvertebrates including trichopterans, dipterans, and ephemeropterans (Hanson 1971, Jacobi 1988, Mangum 1981, 1984, and 1985, McHenry 1986, Mello and Turner 1980, Pittenger 1986, Van Eimeren 1988). The density of aquatic invertebrates in Gila trout streams appears to vary widely (Table 5).

Hanson (1971) reported that Gila trout in Main Diamond Creek were concentrated in pools and used cover (stream improvement structures, branches, logs, and undercut banks) extensively. Rinne (1978) found volume, surface area, and mean depth of pools to be the most important factors in determining Gila trout abundance, biomass, and size in McKnight Creek. Although the number of Gila trout individuals per riffle was similar to the number per pool, Gila trout individuals were significantly larger in pools. The mean size of Gila trout in pools was 134 mm TL, while the mean size in riffles was only 80 mm TL. Important aspects of pool habitat appeared to be volume, mean depth, and maximum depth; while volume, surface area, and percent cover appeared to be the most important aspects of riffle habitat. Less than 2 percent of Gila trout sampled in McKnight Creek were larger than 200 mm TL, and they inhabited pools averaging 0.53 m in depth (Rinne 1978).

Importance of pool depth was also illustrated in a study comparing artificial and natural pools in Main Diamond and McKnight creeks (Rinne 1981). Mean and maximum size of Gila trout in pools created by stream improvement structures were about 25 percent greater than in natural pools, largely because of 40-100 percent greater mean and maximum depths in artificial pools.

Gila trout may be tolerant of high water temperatures. Lee and Rinne (1980) found that Gila trout could tolerate temperatures up to 27°C for up to 2 hours. A high temperature of 22.4°C was recorded in McKnight Creek in 1989 (J. A. Stefferud, pers. comm. 1991), and 27°C in 1978 (J. N. Rinne, USFS, pers. comm. 1991).

Reproduction

Spawning activity of Gila trout started in early April at lower elevations in South Diamond and McEnight creeks and continued through June at higher elevations (Rinne 1980). Spawning begins when temperatures reach about 8°C. Stream flow is apparently of secondary importance in triggering spawning activity (Rinne 1980). Female Gila trout typically construct redds near one bank (about 1/4 of a stream width away) in water 6-15 cm deep within 5 m of cover. Nests are 3-4 cm deep in fine gravel and coarse sand (0.2-3.8 cm) substrate. Redd size varies from <0.1-2.0 m². Spawning activity typically occurs between 1300 and 1600 hours. Rinne noted one pair of fish normally occurred over a redd and spawning behavior was typical of salmonids. Females first reach sexual maturity at Age-3 in McEnight Creek and at Age-4 in Main Diamond Creek (Nankervis 1988).

Table 5. Density of aquatic macroinvertebrates in selected streams with Gila trout populations.

<u>Stream</u>	<u>Date</u>	<u>Aquatic Invertebrate Density (#/m²)</u>	<u>Source</u>
Main Diamond	1962	810	Regan 1964
	1969	1911-1934	Hanson 1971
	1984	892-903	McHenry 1986
south Diamond	1975	151	Mello & Turner 1980
	1976	185	Mello & Turner 1980
	1984	1668	McHenry 1986
Burnt Canyon	1976	69	Mello & Turner 1980 ...
Iron	1975	162	Mello & Turner 1980
	1976	197	Mello & Turner 1980
	1984	591-915	McHenry 1986,
spruce	1975	162	Mello & Turner 1980
	1984	521	McHenry 1986
McKenna	1974	232	Mello & Turner 1980
	1975	266	Mello & Turner 1980
	1984	1239	McHenry 1986
McKnight	1976	208	Mello & Turner 1980
	1984	1147	McHenry 1986
Big Dry	1984	602	McHenry 1986
	1984	660-1632	Mangum 1984
	1985	696-1029	Mangum 1985

Fecundity

Regan (1964) reported 96 and 196 eggs from two Gila trout from Main Diamond Creek and a mean of 150 eggs per female Gila trout from Glenwood Hatchery (N=15, TL 185-270 mm, weights not reported). Hanson (1971) reported a mean of 75.6 eggs per female from Main Diamond Creek in 1969 (N=5, lengths and weights not reported) when condition factors were lower than during Regan's study. Nankervis (1988) found the relationship between total length and ova number was $\log_{10}F = -3.0738 + 2.3305 \times \log_{10}TL$ ($r^2 = 0.92$) for Gila trout in Main Diamond Creek and $\log_{10}F = -3.5443 + 2.6078 \times \log_{10}TL$ ($r^2 = 0.92$) for Gila trout in McKnight creek. Gila trout in Main Diamond Creek had a mean of 2.54 ova/g body weight and Gila trout in McKnight Creek had a mean of 3.33 ova/g body weight (Nankervis 1988). Behnke and Zarn (1976) reported a general figure of 2.20 ova/g body weight for native trouts.

Growth

Fry (20-25 mm TL) emerged from redds in 56-70 days and inhabited riffle areas (Rinne 1980). By the end of the first summer, fry attained a total length of 70-90 mm in lower elevation streams and 40-50 mm in higher elevation streams (Rinne 1980). Turner (1986a) reported similar rates of growth during the first growing season with Gila trout in Iron Creek attaining a mean TL of 49 mm and 84 mm in Little Creek. Growth rates are variable, but Gila trout generally reach 180-220 mm TL by the end of the third growing season in all but higher elevation streams (Table 6).

Condition

Condition factor of Gila trout varies spatially, temporally, and within populations (Table 7). Changes in physical habitat that affect Gila trout density and aquatic macroinvertebrate populations may be causes of variation in condition factor (Turner 1989).

Biomass

Biomass of Gila trout ranged from 2.6-20.0 g/m² in 1985 in Main Diamond, South Diamond, McKenna, Iron, Spruce, McKnight and Big Dry creeks (McHenry 1986). McHenry (1986) noted that biomass fluctuated over time in relation to changes in stream flow, water temperature, cover, and water quality and that spatial variation in biomass was the result of pool habitat distribution and volume.

Food Habits

Regan (1964) reported that adult dipterans, trichopteran larvae, ephemeropteran nymphs, and aquatic coleopterans were the most abundant food items in stomachs of Gila trout in Main Diamond Creek. There was little variation in food habits over the range of size classes sampled (47-168 mm TL). These taxa were also predominant in stomach contents of other trout species in the Gila River drainage, indicating the potential for interspecific competition.

Table 6. Length (mm) at age of Gila trout in selected streams.

Stream (Year Collected)	Number of Fish	Age								
		1	2	3	4	5	6	7	8	9
Sheep Corral (1983) ^a	14	77 [*]	138	204	243					
Little (1986) ^b	25	94	191							
(1985) ^c	—	84	165							
(1984) ^d	27	89	148	211						
South Diamond (1983) ^a	25	69	124	182	223	256				
(1975) ^a	13	85	143	219	303	337				
spruce (1983) ^a	18	77	135	180	250					
McKnight (1988) ^{e,f}	22	69	119	162	185	204				
(1987) ^{e,f}	58	63	128	158	190	206	248	274		
(1983) ^a	37	73	131	182	223	267				
(1976) ^a	18	102	179	235	290					
Main Diamond (1988) ^{f,i}	32	44	84	107	125	142	152	170		
(1969) ^g	152	45	86	120	157	163				
Iron (1986) ^h	58	53 ⁱ	104	147	177					
(1985) ^e	19	56	103	161	231					

* Back-calculated mean TL at annulus (mm)

^a From Turner (1986a)

^b From Turner (1989), October 18-19, 1986 data (page 64)

^c From Turner (1986a), actual mean total length at the end of the growing season of Gila trout hatched in Little Creek.

^d From Turner (1986a), Gila trout transplanted from McKenna Creek in December 1982

^e From Turner (1989)

^f From Turner (1989), data from the Control Zone of the Lower Study Area (page 43)

^g From Hanson (1971)

^h From Turner (1989), weighted means of all 1986 samples combined (page 76)

ⁱ Age determined from otolith measurements.

Table 7. Condition factor by size class of several populations of **Gila** trout, from Turner (1989).

Length	<u>Iron Creek</u>		<u>Spruce Creek</u>		<u>Little Creek</u>			<u>McKnight Creek</u>				
	08/85	08/86	10/84	10/85	08/84	08/85	08/86	09/84	10/85	10/86	10/87	10/88
50-74	0.98	1.05	1.14	1.06	0.92	0.97	0.95	---	---	---	---	---
75-99	0.99	1.00	1.14	0.96	0.91	---	1.01	0.80	0.99	0.95	0.93	---
100-124	1.02	0.93	1.13	1.00	---	1.05	0.97	0.79	0.95	0.87	0.93	1.01
125-149	1.04	0.93	1.07	0.99	a--	0.99	1.02	0.88	0.96	0.98	0.91	1.04
150-174	1.12	1.09	1.04	0.99	0.99	1.03	1.01	0.92	0.96	1.00	0.91	1.04
175-199	---	0.97	0.91	0.90	0.99	0.96	1.00	0.87	1.06	1.03	0.88	1.09
200-224	---	---	0.93	1.03	0.97	0.98	---	0.89	1.01	1.03	0.98	1.06
225-249	---	---	---	---	---	---	---	---	0.95	0.96	1.05	1.23
250-274	---	---	---	---	0.92	---	---	---	---	---	---	---

Van Eimeren (1988) compared the food habits of *Gila* trout and speckled dace in Little Creek and found no significant overlap in diet despite the fact that the two species were found in general proximity. Large *Gila* trout occasionally consumed speckled dace. *Gila* trout diet shifted on a seasonal basis as the relative abundance of various prey taxa changed. In February, dipteran larvae (primarily Simuliidae) were very abundant in the stream and were the principal prey of *Gila* trout. By May, the principal prey shifted to ephemeropteran nymphs (primarily *Paraleptophlebia* sp.) that were present at densities of 1,541/m². No single prey taxon dominated the diet of *Gila* trout in June. In October, *Gila* trout shifted to consuming primarily terrestrial insects and benthic *Helicopsyche* sp. (Trichoptera: Helicopsychidae). *Gila* trout fed mainly between the hours of 0900 and 1300, while speckled dace fed primarily between the hours of 2100 and 1300. As in Regan's (1964) study, there was a large overlap in food habits throughout all size classes of *Gila* trout.

Hanson (1971) noted that *Gila* trout established a feeding hierarchy in pools during a low flow period in Main Diamond Creek. Larger fish aggressively guarded their feeding stations and chased away smaller fish.

FACTORS AFFECTING POPULATION PERSISTENCE

Shaffer (1981) developed a model of population viability based on terrestrial organisms characterized by relatively large, long-lived organisms with low reproductive rate and broad habitat requirements. Four groups of factors were defined that influence the persistence of populations: (1) genetic factors that affect reproduction, survival, and adaptability; (2) demographic factors such as fecundity, sex ratio, and age of sexual maturity; (3) environmental factors that are random and affect habitat; and (4) metapopulation dynamics that affect gene flow between populations and recolonization following local extinctions.

Murphy et al. (1990) expanded this model to include small-bodied organisms with high reproductive rate, short life span, and specific habitat requirements in a population viability analysis of the threatened bay checkerspot butterfly (*Euphydryas editha bavensis*). Habitat fragmentation had resulted in remnant populations of high density. They reported that environmental and metapopulation characteristics were the main determinants of population persistence.

Fragmentation of the historic distribution of *Gila* trout has resulted in several populations confined to small, isolated habitats. These remnant populations characteristically have high densities during relatively stable flow periods (Platts and McHenry 1988). Thus, environmental and metapopulation factors are likely to be most important in affecting population persistence. Metapopulation dynamics are absent among *Gila* trout populations because of physical isolation. Natural gene flow among populations no longer exists and no downstream source for recolonization following extinction of a population is possible.

The overall importance of environmental factors, specifically stages and changes in stream discharge, in determining persistence of *Gila* trout populations is evidenced by the effects of fire, flood, and low flow on

population size and density of this species. The elimination of the Gila trout population in Main Diamond Creek and extreme reduction of population size in South Diamond Creek following the Divide Fire and subsequent flooding provide a vivid example. Several investigators have indicated the importance of discharge in the population dynamics of Gila trout (McHenry 1986, Mello and Turner 1980, Regan 1964, Turner 1989). Winter low flow period has been suggested as an important factor in determining population size (J. A. Stefferud, pers. comm. 1991).

Drought

Droughts cause varying degrees of reduced stream flow that result in a contraction of available habitat and increased mortality of Gila trout. The extreme effect is interrupted or total cessation of surface flow, as occurred in South Diamond Creek in 1989. Riffle areas may become desiccated, reducing macroinvertebrate food production and spawning areas. Reduced pool depth and volume increase the vulnerability of Gila trout to predators (e.g., raccoons, herons, garter snakes), increase water temperature and associated levels of stress, and intensify intraspecific competition.

Flood

Flood events can cause channel scouring, habitat alteration, year class failure, and displacement and mortality of Gila trout. A flood in McKnight Creek in August 1988 virtually eliminated the 1988 year class and markedly reduced abundance of Age-1+ Gila trout (Turner 1989).

Fire

Intense fire can result in increased water temperature, decreased stream shading, increased soil erosion, increased runoff, and increased peak flows (Amaranthus et al. 1989, Dennis 1989). Recovery of a stream after wildfire may vary from several years (Novak 1988) to more than 20 years (Roby 1989).

A large wildfire and ensuing intense thunderstorms in Beaver Creek, Montana, nearly eliminated a resident rainbow trout population (Novak 1988). Similarly, a large wildfire in the headwaters of McKnight Creek in 1951 eliminated a population of rainbow trout (Hanson 1971). A fire in 1951 in Little Creek reportedly eliminated a trout population there also (P. R. Turner, fidae D. Campbell, pers. comm. 1991). The channel of McKnight Creek is still adjusting to the changes in dynamic equilibrium caused by the 1951 fire (Medina and Martin 1988). Populations of trout in three streams on the Prescott National Forest apparently were eliminated by the Dude Fire in 1990 (J. N. Rinne, USFS, pers. comm. 1991). Suspended sediment in one of the streams following the fire was 700,000 ppm.

Similar events occurred in Main Diamond Creek in 1989 with the Divide Fire. The fire was followed by thunder and hailstorms. Resultant runoff, erosion, and sedimentation destabilized the watershed and stream channel and adversely affected water quality. Suspended sediment during a period of runoff following the fire was 73,724 ppm (P. R. Turner, pers. comm. 1991). Sampling

in October 1989 and May 1990 confirmed that the population of **Gila** trout in Main Diamond Creek had been eliminated (Propst et al. 1992).

Estimated historical fire frequencies in vegetation types occurring in watersheds of the **Gila National Forest** are shown below.

<u>Vegetation Type</u>	<u>Frequency of Fire</u>
Ponderosa pine	7 years
Mixed conifer	20 years
Spruce-fir	unknown

In the spruce-fir vegetation type, a succession from New Mexico locust to aspen to spruce-fir takes about 400 years. Fire in the mixed conifer and spruce-fir vegetation types burn either at low or very high intensities (S. Servis, USFS, pers. comm. 1991). The latter situation has the greatest adverse effects on aquatic habitat and fauna.

Results of the Divide Fire caused concern about the potential effect of fire on other populations of **Gila** trout. A summary of the history of fires 16 ha and larger since 1905 in the watersheds of streams with **Gila** trout populations indicates that Iron Creek, with large stands of mixed conifer and spruce-fir in the upper watershed and at least 85 years of fuel accumulation, appeared to be at greatest risk (Table 8).

Grazing

Grazing by domestic livestock affects the population persistence of many southwestern fishes (Miller 1961, Behnke and Zarn 1976, Rinne and Minckley 1991). Studies that specifically investigate the effects of livestock grazing on **Gila** trout have not been done; however, there is considerable information documenting the effects of livestock grazing on other trout species and their habitats. Improper livestock grazing has usually degraded streams and their riparian environments, resulting in decreased production of salmonids (see Platts 1990, Platte 1991 for reviews). The extent of livestock grazing in habitats occupied by **Gila** trout is limited due to the location and topography of the streams, and is not considered a principal factor in the decline of the species, or restricting its recovery.

Much of the **Gila** Wilderness, where 10 populations of **Gila** trout exist, has not been grazed by domestic livestock for more than 50 years. Access by livestock is restricted by the extreme ruggedness of the terrain and lack of grass forage (U.S. Forest Service 1986). Seven of the 13 streams occupied by **Gila** trout are not grazed; 5 are in cattle allotments and one is grazed by horses under an outfitter/guide permit (Table 9). Of the streams within allotments, livestock are restricted from Main Diamond, Sheep Corral, and Sacaton creeks by pasture fences or topography; only South Diamond, McKnight and Little creeks are directly affected by livestock grazing.

Table 8. Fire history since 1905 in **watersheds** of streams with indigenous and **translocated** populations of **Gila** trout,

<u>Stream</u>	<u>Date of Fire</u>	<u>Size of Fire (ha)</u>	<u>Name of Fire</u>
Main and South Diamond creeks	09 Jul 1989	4,010	Divide
McKenna Creek	1950	?	?
	15 Sep 1953	356	Trail Canyon #1
	10 Jun 1956	92	McKenna
Iron Creek - no fires since 1905 in the portion of the stream inhabited by Gila trout.			
Spruce Creek	22 May 1925	136	Spruce Creek
	22 May 1925	2,366	Big Dry
	1951	?	?
McKnight Creek	22 Jun 1951	16,160	McKnight
Sheep Corral Creek	13 Jun 1922	218	Sheep Corral canyon
	15 Jun 1989	480	Shelley
Little Creek	1909	1,600	Little River
	1913	1,000	?
	1913	40	?
	05 Jun 1918	80	McKinney Park
	28 May 1922	902	Little Creek
	13 Jun 1922	61	Johnson Canyon
	1946	?	?
	02 Aug 1952	50	Trail canyon
	22 Aug 1953	39	West Fork
	20 Aug 1956	64	EE
	09 Jun 1978	22	Cliff
	15 Jun 1983	30	Another (PNF)
	13 Jun 1985	1,114	Granite
	16 Jun 1987	300	Nat
	23 Jun 1987	2,240	Sycamore
Big Dry Creek	22 May 1925	2,366	Big Dry

Table 9. Stream5 occupied by Gila trout, their location, and name of the grazing allotment through which they flow.

<u>Water</u>	<u>Wilderness Location</u>	<u>Grazing Allotment</u>
Main Diamond	Aldo Leopold	South Fork
South Diamond	Aldo Leopold	Diamond Bar
Iron	Gila	
McKenna	Gila	
Spruce	Gila	
McKnight		Powderhorn
Sheep Corral	Gila	Cow Creek/Sapillo
Little	Gila	horses only
Dry	Gila	
Trail	Gila	
Mogollon	Gila	
Sacaton	Gila	Sacaton
White	Gila	

The extent of grazing effects on habitats of Gila trout is equivocal. In McKnight Creek, McHenry (1986) determined that 29 to 34 percent of the bank length was eroding, but did not identify a causative factor. Medina and Martin (1988) found no evidence that plots available for light cattle use responded differently from protected plots to channel and vegetation changes in McKnight Creek. Hello and Turner (1980) advised reducing dense stands of riparian vegetation in portions of South Diamond Creek, but in other portions. recommended planting riparian species to stabilize the streambanks and provide cover for trout. McHenry (1986) found 100 percent of the streambanks in South Diamond Creek were stable in 1984.

Estimates of density and biomass of Gila trout in grazed and ungrazed stream5 provide ambiguous conclusions. McHenry (1986) measured density (fish/m²) and biomass (g/ma) of Gila trout in seven stream5 (Dry, Iron, Main Diamond, McKenna, McKnight, South Diamond, and Spruce creeks). Both were highest in South Diamond Creek, but the author noted that they may have been influenced by recent stream discharge patterns. He also provided evidence that the temporal variability in biomass of Gila trout was high, probably a result of natural streamflow patterns.

Catastrophic fires, floods, and drought periodically occur in natural systems, and cause fish populations to vary considerably in abundance. In southwestern North America, rivers are strongly influenced by floods that are sudden and of large magnitude. Extreme floods from spring snowmelt, regional winter rains, and late summer monsoon5 are followed by mere trickles during early summer and autumn droughts. Stream channel conditions reflect these variations in discharge, as do fish populations. In addition, the ability to accurately estimate fish population5 without causing direct harm to individual fish is limited.

The relationships between livestock grazing and fisheries are just beginning to be understood. The season, timing, and amount of cattle use, and the

landform and geomorphological characteristics of the watershed all have variable influences on riparian and stream environments. The interactions of these, and other, variables produce extremely complicated scenarios that resource managers must deal with. Under some grazing strategies, the streamside environment is scarcely touched by cattle; under others it is strongly affected. Platte (1991) noted, "The solution to the livestock-fishery issue is certainly not to argue whether livestock grazing degrades riparian and aquatic systems, but to identify and develop grazing strategies that are compatible with fish habitat productivity."

ESTABLISHING A TRANSLOCATED POPULATION: A CASE HISTORY

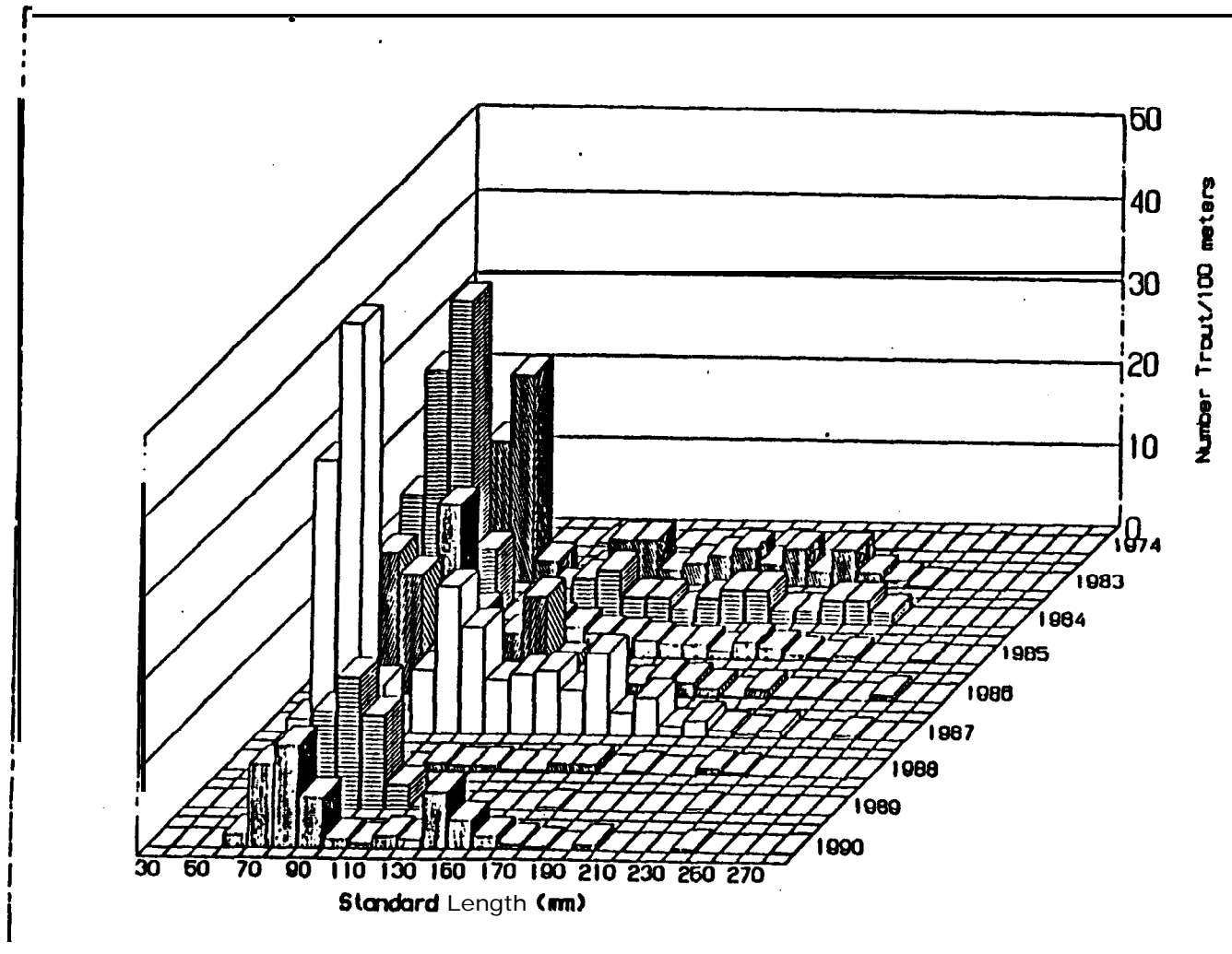
Replication of populations of *Gila* trout and expansion of present distribution is not simply a matter of translocating *Gila* trout into a renovated or barren stream. Factors affecting population persistence (e.g., low flow, fire, flood) mandate monitoring of translocated populations to determine population status and to assess change in habitat condition. Dynamic of the translocated population in McKnight Creek demonstrate fluctuations that occur in a population of *Gila* trout inhabiting a headwater stream environment. Other *Gila* trout populations undergo similar fluctuations in population size, structure, and abundance due to the rigorous conditions in small headwater streams.

In November 1970, 307 *Gila* trout were transplanted from Rain Diamond Creek to McKnight Creek (above an artificial barrier). A drought in 1971 reduced the population to about 20 individuals, 50 an additional 110 *Gila* trout were translocated from Main Diamond Creek in April 1972 (Mello and Turner 1980). The population then remained relatively stable, with increasing numbers, from 1974 to 1983 (Turner and McHenry 1985). This trend is depicted in a comparison of length frequencies from 1974 and 1983 (Figure 3). Flooding in 1984 displaced log stream improvement structures and scoured the channel (Medina and Martin 1988, Turner 1986b and 1989); however, fish survived the high flow and shifting substrate. Pool habitat throughout the stream was still available after the flood (J.A. Stefferud, pers. comm. 1991). Following the 1984 flood were several years of stable flows and stable populations (Table 3). Flooding occurred again in 1988. Channel scouring was caused by mobilization of downed timber in North Fork McKnight Creek. Wide, shallow riffle habitat was the predominant habitat type after the flood, with only occasional pools (J.A. Stefferud, pers. comm. 1991). The 1988 flood resulted in virtual elimination of the 1988 year class and abundance of all other size classes was reduced (Figure-3). However, the surviving sexually mature fish spawned in 1989 and reproduced. Based upon size distribution and density, it appears the population is recovering (D. L. Propst, pers. comm. 1991) (Figure 3).

COMPARATIVE ECOLOGY OF GILA, RAINBOW, AND BROWN TROUT

Turner and McHenry (1985) compared various population characteristics such as growth rate, relative stock density, standing crop, and maximum size among *Gila*, rainbow, and brown trout.

Figure 3. Length-frequency of **Gila** trout in **McKnight** Creek, 1974 through 1990.



The growth rate of Gila trout was similar to that of rainbow trout in similar habitats in Arizona, New Mexico, and Montana. Brown trout were found to have higher growth rates, but much depended upon population density. Also, brown trout apparently had poorer over-winter and post-flood survival and weights 10-20 percent less than Gila trout of the same length (Turner and McHenry 1985). Platte and McHenry (1988) found Gila and Apache trouts to have higher biomass than other trout species in western North America. Relative stock density (RSD_{18} and RSD_{20}) was found to be higher in brown trout and similar in rainbow trout populations compared to Gila trout populations, but there was a high degree of temporal and spatial variabilities (Turner and McHenry 1985). Fastest growth rate and maximum length appeared to be associated with low density in Gila trout populations. Under these circumstances, Gila trout appear to have the potential to attain similar sizes as non-native trouts.

Population density was experimentally manipulated in Main Diamond Creek to determine effect upon growth rate of Gila trout (Nankervis 1988). A 73 percent reduction in biomass resulted in slightly improved condition.

SPORT FISHING POTENTIAL

The susceptibility of native trout, as compared to brown trout, to angling has been pointed out by several investigators (Behnke and Zarn 1976, Behnke 1979, Turner and McHenry 1985). This fact may be cause for concern about the effect of angling on Gila trout, since the intent of the recovery plan is to expand the distribution and numbers of Gila trout. However, Behnke (1979) stated that "no rare or endangered trout has become so through overfishing; the fear that fishermen might exterminate a population is simply not based in fact." Also, regulations can be promulgated to maintain sport fishing consistent with "healthy" populations.

From the results of investigations in small headwater streams, it seems probable that Gila trout can provide a unique sport fishery in those streams. In larger, more stable stream environments, Gila trout can also be expected to provide a sport fishery similar to existing non-native trout fisheries and add to the diversity of fishing opportunities.

STRATEGY OF RECOVERY

The Gila trout was once widespread in the upper Gila River Basin, but has declined because of hybridization with and competition by non-native salmonids, and habitat destruction and degradation. Its current distribution is limited to several populations isolated in small headwater streams; Recovery efforts are intended to increase distribution and reduce probability of extinction of relictual indigenous lineages.

Recovery of Gila trout will serve to maintain biological diversity and restore a native faunal component of the Gila Wilderness. Maintenance of a genetic lineage that has evolved and adapted over thousands of years will also be accomplished. Restoration streams for translocating Gila trout are solely on Federal land, much of it in designated wilderness.

Recovery efforts have included translocations into headwater streams of all relictual populations. This has involved reclaiming several streams using piscicides. Habitat improvement has been conducted in several streams and studies have been initiated and are ongoing to determine genetic relationships among populations of Gila trout and other trouts. Gila trout are being held in a hatchery and propagation techniques are being investigated. A protocol has been developed and is used in monitoring populations. Public education effort5 are ongoing.

Populations of Gila trout and its habitat will continue to be maintained and improved. This priority will involve monitoring populations and evaluating and enhancing deficient habitat. The second priority is to expand distribution within the historic range by translocating Gila trout from pure population5 into restoration stream.

PART II

RECOVERY

Objective and Criteria

The objective of the recovery plan is to reestablish populations of Gila trout throughout its native range. Relictual populations in the wild are to be maintained. Reestablishment and replication of a relictual population will become a primary objective if that population is extirpated in the wild. Downlisting to threatened status will be considered when all known indigenous lineages are replicated in the wild. In addition to replications, Gila trout must be established in a sufficient number of drainages such that no natural or human-caused event may eliminate a lineage. The estimated date for downlisting is the year 2000. Delisting criteria cannot be addressed at present, but will be determined when downlisting criteria are met. These reclassification criteria are preliminary and may be revised as new data are obtained.

Step-Down Outline

1. Maintenance and enhancement of existing populations of Gila trout and habitat.
 - 1.1. Monitor Gila trout populations and their habitats.
 - 1.2. Evaluate and enhance habitat of Gila trout where appropriate.
 - 1.3. Establish and maintain barriers against incursion of non-native salmonids.
 - 1.4. Regulate human activities that may have adverse effects on Gila trout.
 - 1.41. Discontinue introduction of non-native fish into potential or actual habitat of Gila trout.
 - 1.42. Prohibit the taking of Gila trout.
 - 1.43. Evaluate effect of sport fishing on populations of Gila trout.
 - 1.5. Investigate impacts of livestock grazing upon Gila trout habitat.
 - 1.6. Enforce established regulations to eliminate or minimize threats.
 - 1.61. Inform appropriate agencies of their management and enforcement obligations.
 - 1.62. Ensure compliance with section 7 of the Endangered Species Act.

2. Reestablish **Gila** trout in its historic range.
 - 2.1. Characterize components of habitat of **Gila** trout.
 - 2.2. survey streams within the historic range to identify sites with suitable characteristics for **Gila** trout.
 - 2.3. Select potential streams for restoration.
 - 2.4. Conduct remedial actions necessary to make selected streams suitable for reestablishment.
 - 2.5. Establish **Gila** trout in selected restoration streams from known pure populations.
 - 2.6. Monitor populations of **Gila** trout in restoration streams.
 - 2.7. Take steps to maintain the integrity of native aquatic communities after **Gila** trout are established in restoration streams.
3. Determine taxonomy and systematic8 of **Gila** trout.
 - 3.1. Conduct a biochemical assay of each new suspected population before it **is replicated**.
 - 3.2. Develop protocol for recombining lineages within **Gila** and San Francisco drainages.
4. Disseminate information about **Gila** trout.
 - 4.1. Provide information to the general public regarding the **Gila** trout and recovery efforts.
5. Use hatchery facilities and artificial propagation as tools to enhance recovery efforts.
 - 5.1. Use hatcheries as refugia.
 - 5.2. Determine artificial propagation requirements.

Narrative Outline

1. Maintenance and enhancement of existing populations of **Gila** trout and habitat.

- 1.1. Monitor **Gila** trout populations and their habitats.

Monitor all populations of **Gila** trout on a long-term basis (see Appendix A: Monitoring Protocol for **Gila** Trout Populations). Should monitoring data suggest decline in a population or degradation of habitat, identify and remedy causative agents.

- 1.2. Evaluate, protect, and enhance habitat of **Gila** trout where appropriate.

Evaluate watershed condition including stream hydrograph, runoff characteristics, erosivity, gullying, herbaceous and woody vegetation characteristics and condition, and effects of past and present management practices. Identify watershed restoration needs and implement restorative measures. Identify need5 for **instream** habitat restoration and improvement. Plan and implement **instream** habitat improvement in a watershed context and with respect to hydrologic effects that habitat structures may have. Any enhancement activity planned within wilderness areas will be consistent with wilderness designation and **objectives**.

- 1.3. Establish and maintain barriers against incursion of non-native salmonids.

Establish a barrier in a restoration stream if one does not exist. If any existing natural or artificial barrier loses **its** effectiveness, the replacement or enhancement of that barrier will be carefully planned and executed in harmony with the natural environment.

- 1.4. Regulate human activities that may have an adverse effect on **Gila** trout.

- 1.41. Discontinue introduction of non-native fish into potential or actual habitat of **Gila** trout.

As a major threat to the integrity and survival of populations of **Gila** trout, non-native fish, especially trout, must be restricted from actual or potential habitat.

- 1.42. Prohibit the taking of **Gila** trout.

Federal regulations prohibit the taking of **Gila** trout and state regulations reflect this. Ensure all necessary personnel of appropriate agencies are informed of regulations concerning **Gila** trout. Identify areas where fishing for **Gila** trout exists and may have an effect on the population. Post **signs** at identified streams containing **Gila** trout declaring that the water is closed to fishing.

- 1.43. Evaluate effect of sport fishing on populations of **Gila** trout.

- 1.5. Investigate impacts of livestock grazing upon **Gila** trout habitat.

Grazing of domestic livestock currently affects only South Diamond, McKnight, and Little creeks. Monitoring of selected **Gila** trout habitat parameter5 should be initiated to determine the effects of grazing on these streams, and

potential reintroduction streams. The effects of domestic livestock grazing upon **Gila** trout and its habitat must be considered when grazing allotment management plans are reviewed and re-written, or within the time frame of this plan. Grazing strategies that are compatible with fish habitat productivity should be developed to ensure conservation of the species.

1.6. Enforce established **regulations** to eliminate or **minimize** threats.

Existing regulations have been established to control human activities that may adversely affect the species or its habitat. As studies are completed, new information may indicate that additional regulations and/or strategies are necessary. If additional control of human activities is needed, recommendations with justifications will be made to establish and enforce new regulations to minimize threats.

1.61. Inform appropriate agencies of their management and enforcement obligations.

Agencies and the public should be made aware of their responsibilities under laws protecting listed species and their habitats (i.e., Endangered Species Act, Clean Water Act, **Lacey** Act).

1.62. Ensure compliance with section 7 of the Endangered Species Act.

Section 7 will continue to play a role in the protection and recovery of the **Gila** trout. Every effort will be made to ensure that Federal actions are not likely to jeopardize the continued existence of the species and that Federal agencies utilize their authorities to promote recovery of the species.

2. Reestablish **Gila** trout in its historic range.

2.1. Characterize components of habitat of **Gila** trout.

Habitat of streams containing **Gila** trout will be characterized to provide baseline physical, chemical, and biological data for use in evaluation of potential restoration streams.

2.2. Survey streams within the historic range to identify sites with suitable characteristics for **Gila** trout.

The following factors will be considered prior to final selection of restoration streams.

- A. The ability to eliminate and exclude non-native fish by either physical and/or biological methods must be assured.

- B. A suitable barrier or site for barrier construction must be present to eliminate potential upstream movement of non-native fish species into restored areas. Location of the barrier site should provide for maximum population expansion of Gila trout. The barrier should also reduce the possibility of illegal, purposeful introduction of other fish species upstream of it.
- C. Evaluate potential restoration streams in terms of physical, chemical, and biological parameters that affect the suitability of the habitat to maintain populations of Gila trout. Existing fish community structure of restoration streams will be determined and used for measuring success of restoration. Evaluate the hydrographic history, fire potential, and watershed condition of potential restoration streams. Presence of other species in candidate restoration streams will be determined and potential impacts of barrier construction, toxicant application, and/or Gila trout introduction will be assessed in order to maintain biodiversity and native fauna.
- D. Existing access and present angler use will be considered in evaluation of candidate restoration streams. Characteristics of access affect logistic stream reclamation, transplant operations, and research and law enforcement activities. Access also affects potential for introduction of undesirable fish species and levels of angler use of Gila trout. The initial goal of the Recovery Plan is to secure and maintain viable populations of the species in its native range. However, accomplishment of this goal will lead to public fishing opportunities. Public acceptance of restoration is a desirable goal and will serve to facilitate future management of Gila trout.

2.3. Select potential stream for restoration.

Potential restoration streams will be selected according to criteria listed under "RESTORATION METHODS, Evaluation Criteria for Candidate Restoration Streams" on page 16 of this Recovery Plan.

2.4. Conduct remedial actions necessary to make selected streams suitable for reestablishment.

Some examples of remedial action include habitat improvements such as log stream improvement structures, prescribed burning, and chemical renovation of the stream.

2.5. Establish Gila trout in selected restoration streams from known pure populations.

The indigenous lineages of Gila trout differ genetically and morphologically to some degree and each lineage is considered vital to survival of the species. In an effort to ensure that this diversity is maintained, each lineage will be replicated using wild

or captive stocks of known purity. Multiple stockings will be conducted where appropriate.

2.6. Monitor populations of *Gila* trout in restoration streams.

Establishment of *Gila* trout in restoration streams will be monitored to document reproductive success, young-of-the-year survival, growth rates, and other parameters. Monitoring will be conducted in accordance with monitoring protocol (see Appendix A).

2.7. Take steps to maintain the integrity of native aquatic communities after *Gila* trout are established in restoration streams.

Steps will be taken to maintain the native aquatic community after establishment of *Gila* trout. Introduction of native fish species will be conducted, one species at a time, when it is deemed that it will have no effect on reestablishment of the *Gila* trout population. Species that may have occurred with *Gila* trout include longfin dace (*Aosia chrysotaenia*), speckled dace (*Rhinichthys osculus*), spinedace (*Meda fulgida*), loach minnow (*Tiaroga cobitis*), roundtail chub (*Gila robusta*), desert mountain sucker (*Pantosteus clatki*), and Sonora sucker (*Catostomus snyderi*).

3. Determine taxonomy and systematics of *Gila* trout.

There is considerable evidence that the lineages of *Gila* trout are morphologically and genetically different. Genetic analysis will provide information critical for making decisions about translocation sites for each lineage. Comprehensive analysis of genetic variation and relationships among lineages will be conducted.

3.1. Conduct a biochemical assay of each new suspected population before it is replicated.

3.2. Develop protocol for recombining lineages within *Gila* and San Francisco drainages.

4. Disseminate information about *Gila* trout.

Disseminate information concerning *Gila* trout to provide knowledge and understanding of the *Gila* trout and the recovery effort.

4.1. Provide information to the general public regarding the *Gila* trout and recovery efforts.

Provide basic information on the species and reasons for its restoration. Disseminate information about *Gila* trout to the public on a local and state basis to reach as large and as varied an audience as possible. Provide information to appropriate media. An information and education program will be implemented to inform people of regulations concerning *Gila* trout. This information will be presented in the fishing proclamation. Displays will be

developed at appropriate locations. Technical information will be made available through scientific journals, agency reports, and presentations at scientific meetings.

5. Use hatchery facilities and artificial propagation as tools to enhance recovery efforts.

Make use of available hatchery facilities to enhance recovery efforts by providing refugia for threatened, wild populations. In addition, fish culture techniques will be used to provide a source of Gila trout stock for recovery, research, and future enhancement efforts.

5.1. Use hatcheries as refugia.

If the existence of any Gila trout population is seriously threatened, every possible attempt will be made to transplant individuals into a refuge stream as soon as possible. If a stream transplant is not immediately feasible, individuals from the population will be transferred to a hatchery that can serve as a temporary holding facility until a stream is located to receive them. The hatchery site selected will be specific pathogen-free and have fish culture facilities that can effectively isolate Gila trout from other salmonids. Candidate hatcheries will be investigated and cleared for use as refugia well in advance of any anticipated need. In addition, wild populations of special concern will be certified disease free as a precursory measure that will allow unrestricted transfer to hatchery facilities.

5.2. Determine artificial propagation requirements.

Gila trout representing the type locality, Main Diamond Creek, will be held and propagated at a hatchery meeting the requirements listed above. Selection procedures for hatchery stock will include safeguards to ensure that captive genomes reflect the genetic integrity found in the original stock.

Numbers of trout held will be determined in part by minimum population sizes required to maintain genetic integrity and requirements needed to produce approximately 5,000 fingerling Gila trout per year. This number does not include reproduction required to sustain broodstock programs.

Maintenance of captive stock will include measures to ensure that sequential generations of Gila trout maintain diversity found in the parent, wild population. These measures will include no less than a 10 percent infusion of wild gametes every 5 years. Year classes of captive broodstock will be monitored by biochemical means to confirm the effectiveness of genetic maintenance procedures.

Propagation facilities and procedures will include and complement plans to use wild gametes in combination with those of hatchery stock. These programs will be designed to accommodate limited

production of other genotypes or allow recombination of genotypes designed to improve survival for restoration efforts targeted at more diverse habitats.

PART III

IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows outlines the actions and costs for the Recovery Program. It is a guide for meeting the objectives elaborated in Part II of this plan. This schedule indicates recovery plan tasks, corresponding outline numbers, task priorities, duration of tasks ("ongoing" denotes a task that once begun should continue on an annual basis), responsible agencies, and, lastly, estimated cost for the Fish and Wildlife Service tasks. When accomplished, these tasks should bring about the recovery of the Gila trout and protect its habitat.

KEY TO IMPLEMENTATION SCHEDULE COLUMNS

Definition of Priorities

- Priority 1: All actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable, future.
- Priority 2: All actions that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.
- Priority 3: All other actions necessary to provide for full recovery of the species.

Abbreviations

ES	New Mexico Ecological Services State Office
FR	Fishery Resources
AZ	Arizona Game and Fish Department
NMGF	New Mexico Department of Game and Fish
FS	U.S. Forest Service
LE	Law Enforcement

PART III - IMPLEMENTATION SCHEDULE

PLAN	TASK	TASK			RESPONSIBLE AGENCY			COST ESTIMATE			COMMENTS
		TASK	PRIORITY	DURATION	FWS		FY94	FY95	FY96		
					PROGRAM	OTHER					
	Monitor populations and habitats	1.1	1	ongoing	2	ES FR	FS NMGF AZ	10,000	10,000	10,000	
	Discontinue introduction of non-native fish	1.41	1	ongoing	2	FR	NMGF				
	Regulate adverse human activities	1.4	1	ongoing	2	ES	FS NMGF AZ				
47	Evaluate and enhance habitat	1.2	2	ongoing	2	ES FR	NMGF FS A5	5,000	5,000	5,000	
	Prohibit taking	1.42	2	ongoing	2	LB	NMGF FS AZ				
	Establish and maintain barriers	1.3	2	ongoing	2	ES FR	NMGF FS	5,000	5,000	5,000	actual cost would depend upon construction cost
	Study grazing impacts	1.5	2	5	2	ES FS	NMGF	5,000	5,000	10,000	

PART III - IMPLEMENTATION SCHEDULE

PLAN TASK	TASK NUMBER	PRIORITY NUMBER	TASK DURATION YEARS	RESPONSIBLE AGENCY			COST ESTIMATE			COMMENTS
				FWS		OTHER	FY94	FY95	FY96	
				REGION	PROGRAM					
Characterize components of habitat	2.1	2	2	2	ES	NMGF F S	2,000	1,000		
Survey streams for possible restoration	2.2	2	2	2	ES FR	FS NMGF AZ				cost included in taek 1.2
Select restoration streams	2.3	2	1	2	ES FR	F S NMGF AZ				selection would take place after completion of task 2.2
Make selected restoration stream suitable and establish Gila trout	2.4	2	ongoing	2	ES	FS	10,000	10,000	10,000	this would be a continuation of of routine recovery efforts
	2.5				FR	NMGF AZ				
Monitor restored populations	2.6	2	ongoing	2	ES FR	FS NMGF AZ				cost included in task 1.1
Maintain the integrity of native aquatic communities	2.7	2	ongoing	2	ES FR	F S NMGF AZ	2,000	2,000	2,000	cost includes the reestablishment of other native
Hold and propagate Gila trout in a hatchery	5.1	2	ongoing	2	FR		40,000	40,000	50,000	production goal is 5,000 fingerlings per year aquatic organisms
	5.2									
Biochemical assay of new suspect populations	3.1	2	2	2	ES FR	NMGF F S AZ	10,000	10,000	10,000	

PART III - IMPLEMENTATION SCHBDULB

PLAN TASK	TASK NUMBER	PRIORITY NUMBER	TASK DURATION YEARS	RESPONSIBLE AGENCY			COST ESTIMATE			COMMENTS
				F	W	S	FY94	FY95	FY96	
				REGION	PROGRAM	OTHER				
Develop a protocol recombining lineagee	3.2	3	1	2	ES	NMGF FS				Recovery Team will do this
Evaluate impact of sport fishing	1.43	3	unknown	2	FR	NMGF FS				Task can be initiated only after a suitable population is established
Information and education	4.1	3	ongoing	2	FWE FR	NMGF FS AZ	2,000	2,000	2,000	production of videos and brochures

LITERATURE CITED

- Amaranthus, M., H. Jubao, and D. Arthur. 1989. Stream shading, summer streamflow and maximum water temperature following intense wildfire in headwater streams. Proceedings of the Symposium on Fire and Watershed Management, October 26-28, 1988, Sacramento, California. USDA Forest Service General Technical Report PSW-109. Pages 75-78.
- American Fisheries Society Western Division. 1980. Management and protection of western riparian stream ecosystems. 24 pages.
- Armour, C.L. 1977. Effects of deteriorated range streams on trout. **Bur. Land Manage.** Idaho State Office, **Boise**. 7 pages.
- Beamish, R. J. and R. R. Miller. 1977. Cytotaxonomic study of the **Gila** trout, Salmo gilae. Journal of the Fisheries Research Board of Canada. 34:1041-1045.
- Behnke, R. J. 1970. Rare and endangered species report: New information on **Gila** trout, Salmo gilae. Colorado Cooperative Fishery Unit, Colorado State University, Fort **Collins**, Colorado. 12 pages.
- _____. 1973. **Gila** trout, Salmo gilae. Endangered Species Report. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 5 pages.
- _____. 1979. Monograph of the native **trouts** of the genus Salmo of western North America. Report funded by USDA Forest Service, U.S. Fish and Wildlife Service, and U.S. Bureau of Land Management (**inquiries:** Regional Forester, 11177 West 8th Avenue, **P.O.** Box 25127, Lakewood, Colorado, 80225). 163 **pages**.
- _____, and **M. Barn**. 1976. Biology and management of threatened and **endangered** western trouts. Technical Report **RM-28**, Rocky Mountain **Forest** and Range Experiment Station, Fort Collins, Colorado. 45 pages.
- Berger, B. L. 1965. **Antimycin** (Fintrol) as a fish toxicant. Address for Delivery at Southern Division of the American Fisheries Society Meeting, Tulsa, Oklahoma. 6 pages.
- _____, R. E. Lennon, and J. W. Hogan. 1969. Laboratory studies on antimycin A as a fish toxicant. Investigations in fish control, 126. USDI Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Washington, D.C. 21 pages.
- Bickle, T. S. 1973. **Gila** trout management plan. USDA Forest Service, **Gila** National Forest, Silver City, New Mexico. 47 pages.
- Brown, D. E. 1982. Biotic communities of the American Southwest-United States and Mexico, Desert Plants. 342 pages.

- Coman, C. H. 1981. **Gila** trout management and recovery activities with **emphasis** on Iron Creek recovery **efforts**. **Mimeo**. **Gila** National Forest, **Silver** City, New Mexico. 34 pages.
- David, R. E. 1976. **Taxonomic** analysis of **Gila** and **Gila** x rainbow trout in mouthwestern New Mexico. Unpublished X.8. Thesis, New Mexico State Univermity, **Las** Crucem, New Mexico. 36 **pages**.
- Dennis, N. 1989. The effects of fire on watersheds: a summary. Sacramento, California. USDA Forest Service General Technical Report PSW-109. Page8 92-94.
- Gilderhum, P. A., B. L. Berger, and R. E. Lennon. 1969. Field trials of antimycin Aas a **fish** toxicant. Investigations in fish control, 127. USDI **Fish** and Wildlife Service, Bureau of Sport **Fisheries** and Wildlife, . Washington, D.C. 22 **pages**.
- Gold, J. R. 1977. **Systematics** of western North American trout, (**Salmo**), with **notes** on the **redband** trout of **Sheephaven** Creek, California. Canadian Journal of Zoology. 55(11):1858-1873.
- Hanson, J. N. 1971. **Investigations** on **Gila** trout, **Salmo gilae** Miller, in southwestern New Mexico. Unpublished W.S. Thesis. **New** Mexico State Univermity, **Lam** Crucem, New Mexico. 44 **pages**.
- Herr, F., E. Greselin, and C. Chappel. 1967. Toxicology **studies** of antimycin, a **fish** eradicant. **Transactions** of the **American Fisheries** Society. 96(3) :320-326.
- Jacobi, G. Z. 1988, Benthic **macroinvertebrate assessment**: benthic macroinvertebrate **samples** from the Mogollon River and **tributaries**, **Gila** National **Forest**, New Mexico. **Unpublished** report. **New** Mexico Highlands University, **Lam Vegas**, New Mexico. 5 pages.
- Kennedy, C. 1977. Wildlife conflict8 in **riparian management**: Water. Pp. 52-58. **In Symposium** on Importance, **Preservation** and **Management** of **Riparian** Habitat. U.S. *For. Serv.*, **Gen.** Tech. Rep. RX-43.
- Lee, R. W., and J.N. Rinne. 1980. Critical thermal maxima of five trout species in the **southwestern** United States. **Transactions** of the American Fisheries Society. 109:632-635.
- Legendre, P., C. B. Schreck, and R. J. Behnke. 1972. Taximetric **analysis** of selected **groups** of western North American **Salmo** with respect to phylogenetic divergences. Systematic Zoology. 21(3):292-307.
- Loudenslager, E. J., and G. A. E. Gall. 1981. Cutthroat trout: **Abiochemical-genetic assessment** of their status and **systematics**. Unpublished &ft report, Department of Animal Science, Univermity of California, Davis, California. 89 **pages**.

- _____, J. N. Rinne, G. A. E. Gall, and R. E. David. 1986. Biochemical genetic studies of native Arizona and New Mexico trout. The Southwestern Naturalist. 31(2):221-234.
- Mangum, F.A. 1981. Aquatic ecosystem inventory - macroinvertebrate analysis, Gila National Forest. USDA Forest Service Annual Progress Report, Forest Service Intermountain Region Aquatic. Ecosystem Analysis Laboratory, Provo, Utah. 3 pages.
- _____. 1984. Aquatic ecosystem inventory - macroinvertebrate analysis, Gila National Forest. USDA Forest Service Annual Progress Report, Forest Service Intermountain Region Aquatic Ecosystem Analysis Laboratory, Provo, Utah. 9 pages.
- _____. 1985. Aquatic ecosystem inventory - macroinvertebrate analysis, Gila National Forest. USDA Forest Service Annual Progress Report, Forest Service Intermountain Region Aquatic Ecosystem Analysis Laboratory, Provo, Utah. 18 pages.
- Marcuson, P.E. 1977. The effect of cattle grazing on brown trout in Rock Creek, Montana. Proj. No. F-20-R-21-11-a, 26 pp. Mont. Dept. Fish and Game, Helena.
- McHenry, M. L. 1986. A test of the habitat quality index in forested headwater streams of the Gila National Forest, New Mexico. Unpublished M.S. Thesis. New Mexico State University, Las Cruces, New Mexico. 73 pages.
- Medina, A. L., and S. C. Martin. 1988. Stream channel and vegetation changes in sections of McKnight Creek, New Mexico. Great Basin Naturalist. 48(3):373-381.
- Mello, K., and P. R. Turner. 1980. Population status and distribution of Gila trout in New Mexico. Endangered Species Report No. 6, U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 53 pages.
- Miller, R. R. 1950. Notes on the cutthroat and rainbow trouts with the description of a new species from the Gila River, New Mexico. Occasional Papers of the Museum of Zoology, University of Michigan, University of Michigan Press, Ann Arbor, Michigan. 529:1-43.
- _____. 1961. Man and the changing fish fauna of the American Southwest. Papers of the Michigan Academy of Science, Arts and Letters. 46:365-404.
- _____. 1973. Classification of the native trouts of Arizona with the description of a new species, Salmo apache. Copeia. 3:401-422.
- Minckley, W. L., 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, Arizona. 293 pages.
- _____, and J.E. Brooks. 1985. Transplantations of native Arizona fishes; records through 1988. Journal of Arizona-Nevada Academy of Science. 20(2):73-89.

- Mulch, E. D., and W. C. Gamble. 1956, Game fishes of Arizona. **Arizona** Department of Game and Fish, Phoenix, Arizona. 19 pages.
- Murphy, D. D., K. E. Fream, and S. B. Weiss. 1990. An **environment-metapopulation** approach to population viability analysis for a threatened invertebrate. *Conservation Biology*. **4(1):41-51**.
- Nankervis, J. M. 1988. Age, growth and reproduction of **Gila** trout in a small headwater stream in the **Gila** National Forest. Unpublished. M.S. Thesis. New Mexico State University, Lam **Cruces**, New Mexico. 58 Pages.
- Needham, P. R., and R. Card. 1959. Rainbow trout in Mexico and California with notes on the cutthroat series. University of California Publications in Zoology. **67(1):1-124**.
- Novak, M.A. 1988. Impacts of a fire-flood event on physical and biological characteristics of a small mountain stream. Unpublished M.S. Thesis. Montana State University, **Bozeman**, Montana. 110 **pages**.
- Pittenger, J. S. 1986. Invertebrate drift before and after trout removal from a southwestern stream. Unpublished M.S. Thesis, New Mexico State University, Lam **Crucem**, New Mexico. 73 pages.
- Platte, W.S. 1990. Managing fisheries and wildlife on rangeland grazed by livestock. Prepared for Nevada Department of Wildlife. Don **Chapman** Coneultantm, Inc. Boise, Idaho
- _____. 1991. Livestock grazing. In: W.R. Meehan, editor. Influences of forest and rangeland management on **salmonid** fishes and their habitats. American Fisheries Society **Special** Publication 19.
- _____, and M. L. McHenry. 1988. Density and biomass of trout and char in western streams. USDA Forest Service General Technical Report INT-241, Intermountain Research Station, Ogden, Utah. 17 pages.
- Propst, D.L. 1988. Investigations and recovery of **Gila** trout. Proj. No. E-7-2, 11 pp. New **Mex.** Dept. **Game and** Fish, Santa Fe.
- _____, J. A. Stefferud, and P. R. Turner. 1992. Conservation and status of **Gila** trout, **Cncorhynchus gilae** (Miller). The Southwestern Naturalist.
- Quinn, J. F., and A. Hastings. 1987. Extinction in subdivided habitats. *Conservation Biology*. **1:198-208**.
- Regan, D. M. 1964. Ecology of **Gila** trout, **Salmo gilae**, in Main Diamond Creek, New Mexico. Unpublished U.S. Thesis, Colorado State University, Fort Collins, Colorado. 57 pages.

- Rinne, J. N. 1978. Development of methods of population estimation and habitat evaluation for management of the **Arizona** and **Gila** trouts. Pages 113-125 in J. Moring, ed. Proceedings of the wild trout - catchable trout **symposium**. Oregon Department of Fish and Wildlife, Corvallis, Oregon.
- _____. 1980. Spawning habitat and behavior of **Gila** trout, a **rare salmonid** of the southwestern United States. Transactions of the American Fisheries Society. **109:83-91**.
- _____. 1981. Stream habitat improvement and native southwestern trouts. **USDA** Forest Service Research Note RM-409, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado. 4 pages.
- _____, and W.L. Minckley. 1991. Native fishes of arid lands: A dwindling resource of the desert southwest. **USDA** Forest Service Research General Technical Report RM-206, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado. 45 pages.
- _____, and P. R. Turner. 1991. Reclamation and alteration as management techniques, and a review of methodology in stream renovation. Pages 400-448 in W. L. Minckley and J.E. Deacon, ed. Battle against extinction: native fish management in the American West. University of Arizona Press, Tucson. Pages 400-448.
- Roby, K. B. 1989. Watershed response and recovery from the Will Fire: ten years of observation. Proceedings of the Symposium on Fire and Watershed Management, October 26-28, 1988, Sacramento, California. **USDA** Forest Service General Technical Report PSW-109. Pages 131-136.
- Schreck, C. B., and R. J. Behnke. 1971. **Trouts** of the Upper **Kern** River Basin, California, with reference to **systematics** and evolution of western North American **Salmo**. Journal of the Fisheries Research Board of Canada. **28:987-998**.
- Shaffer, M. L. 1981. Minimum viable population sizes for conservation. Bioscience. **31:131-134**.
- Smith, G. R., and R. E. Stearly. 1989. The classification and **scientific names** of **rainbow** and **cutthroat trouts**. Fisheries. **14(1):4-10**.
- Sublette, J. E., M. D. Hatch, and M. Sublette. 1990. The fishes of New Mexico. University of New Mexico Press, Albuquerque, New Mexico. 389 pages.
- Thurston, R.V., R. C. Russo, C. M. Fetterolf, Jr., T. A. Edeall, and Y. M. Barber, Jr., eds. 1979. A review of the EPA **redbook**: quality criteria for water. Water Quality Section, American Fisheries Society, Bethesda, Maryland.
- Turner, P.R. 1984. **Gila** Trout Activities During 1984 (**Summary** of Fieldwork Involving **NMSU**). 8 pages.

- _____. 1986a. Restoration of the endangered **Gila** trout. Proceeding8 of the Annual Conference of the Western Association of Fish and Wildlife Agencies. 66:122-133.
- _____. 1986b. **Summary of McKnight Creek Gila trout population status.** Unpublished Report. New Mexico State University, Lam **Cruces**, New Mexico. 21 pages.
- _____. 1989. Annual and seasonal changer in populations of **Gila** trout in **headwater** streams. Final Report to the New Mexico Department of Game and Fish, Santa Fe, New **Mexico**. 93 pages.
- _____, and M. L. McHenry. 1985. Population ecology of the **Gila** trout with **special** emphasis on sport fishing potential. Unpublished final report to New Mexico Department of **Game** and Fish, Santa Fe, New Mexico. 70 pages.
- U.S. Fish and Wildlife Service. 1967. Native fish and wildlife; endangered species. Federal Register. 32:4001.
- U.S. Fish and Wildlife Service. 1975. Endangered and threatened wildlife and plants; reclassification **of** the American alligator and other amendmets. Federal Register. 40:44415.
- _____. 1979. Recovery plan for **Gila** t:Salmo gilae Miller 1950. Mimeo. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 45 pages.
- _____. 1984. **Gila** trout recovery plan. U.S. Fish and Wildlife Service, Albuquerque, New **Mexico**. 52 pages.
- _____. 1987. Endangered and threatened wildlife and plants; proposed reclassification of the **Gila** trout (Salmo gilae) from endangered to threatened. Federal Register. 52x37424-37427.
- _____. 1988. **Gila** trout propagation - Memcalero National Fish Hatchery. FY-88 Regional Funds and Work Guidance, Task Number 22.370. Unpublished. U.S. Fish and Wildlife Service, Memcalero National Fish Hatchery, New Mexico. 4 pages.
- U.S. Forest Service. 1979. Environmental assessment; **Gila** trout recovery projects on the **Gila** National Forest. USDA Forest Service, **Gila** National Forest, Silver City, New Mexico. 51 pages.
- _____. 1986. **Gila** National Forest Plan. USDA Forest Service, Southwestern Region, Albuquerque, New Mexico. 324 pages.
- _____. 1987. Rancher field day August 18, 1987. History. **Gila** National Forest, Silver City, New Mexico. 1 page.
- _____. 1990. Allotment management plan proposal for the Diamond Bar Allotment. **Gila** National Forest, **Mimbres** Ranger District, **Mimbres**, New Mexico. 54 pages.

- Van *Eimeren*, P. A. 1988. **Comparative** food habits of **Gila** trout and **speckled dace** in a southwestern headwater stream. Unpublished M.S. Thesis, New Mexico State University, **Lae Cruces**, New Mexico. 59 pages.
- Walker, C. R., R. E. **Lennon**, and B. L. Berger. 1964. Preliminary observations on the toxicity of **antimycin A** to fish and other aquatic animals. Investigations in Fish Control, vol. 2. U.S. Bureau of Sport Fisheries and Wildlife.
- Warnecke, J. 1987. Fisheries inventory of Gap Creek, Yavapai County, Arizona. Unpublished Report. Arizona Game and Fish Department, Phoenix, Arizona. 9 **pages**.
- Wilcove, D. **S.**, C. H. McClellan, and A. P. Dobeon. 1986. Habitat fragmentation in the temperate zone. Pages 237-256 in **M. E. Soule**, ed. Conservation biology: the science of scarcity and diversity. Sinauer Associates, Sunderland, **Massachusetts**.

APPENDIX A

MONITORING PROTOCOL FOR GILA TROUT POPULATIONS

I. Definition: Established Populations.

For the purpose of this monitoring protocol, an established population is either one of the four relictual populations (Main Diamond, South Diamond, Spruce, and Iron creeks) or a renovated population that has reached the carrying capacity of the renovated habitat. Here, attainment of carrying capacity is determined by comparing the size distribution (age structure) of the trout population in the pretreatment stream (or segment) to that of the Gila trout population inhabiting the stream at the time of assessment. If the size range of the reestablished Gila trout population is similar to that of the pretreatment population and a comparable proportion of individuals occur within each size class, the renovated population will be defined as having attained the carrying capacity of the stream. For example, if individuals in the pretreatment population in late summer ranged in size from ca 50 mm (young-of-year) to 280 mm total length (TL) and the proportion of fish per 50 mm length class is 10% \leq 50 mm, 30% 51-100 mm, 30% 101-150 mm, 10% 151-200 mm, 10% 201-250 mm, and 10% $>$ 251 mm and the reestablished Gila trout population has a similar size-structure (with evidence of successful reproduction and recruitment) with comparable percentages (\pm 5%) in each length class, this Gila trout population may be considered reestablished. Because the foregoing method is rather vague, some latitude should be permitted in making decisions on the status of a particular population.

II. Definition: Nonestablished Populations.

Nonestablished populations, as defined for the purpose of this monitoring protocol, are any (relictual or renovated) that do not meet the requirements given under I.

III. Monitoring Protocol.

A. Methods

1. Two to four permanent sites will be established on each stream. Sites will be selected to encompass the array of habitats available to Gila trout in the stream. The number of sites and length of sites per stream will be dependent upon stream size. Short streams, such as Spruce Creek, will have a minimum of two permanent sites. Longer streams, such as Iron Creek, will have a minimum of four. No permanent site markers will designate sites; rather, location will be on U.S.G.S. 7.5' topographic maps. Reference photo points will be established at each site and photos taken during each sampling effort.

2. Fish collection will be by backpack electrofishing gear. One sampling pass will be made. As many fish as possible will be collected while exercising care to minimize sampling mortality. All collected specimens will be weighed, measured, and returned to the stream live. Any mortalities will be preserved and **curated** with the Museum of Southwestern Biology, University of New Mexico, or the New Mexico Department of Game and Fish. Voltage, amperage, pulse width, and frequency will be recorded for each sampling pass. Time and area electrofished will be recorded.
3. At one permanent site *on* each stream, a population/density estimate (including length/weight data) for each habitat type (*e.g.*, pool, run, riffle, undercut bank) will be accomplished. Data for each habitat type will be recorded separately.
4. At each permanent site water temperature, dissolved oxygen, and **pH** will be measured. If deemed necessary, other water quality parameters will be measured.
5. The entire stream reach supporting **Gila** trout will be visually surveyed to gain an overall impression of the security of the stream and relative habitat quality.
6. All data gathered on each population monitored in a year will be summarized in a brief **report** to be submitted by agency representatives. This report will be submitted to the Regional Director, U.S. **Fish** and Wildlife Service, for **transferral** to relevant agencies.

I v . Schedule.

- A. Established Populations. Routine monitoring of established populations will be conducted every other *year*.
- B. Nonestablished Populations. Routine monitoring *of* nonestablished populations will be conducted annually. Sampling of introduced populations will not begin until 2 years have elapsed since the last stocking of **Gila** trout.
- c. Exceptions. If natural or human-caused perturbations are believed to have significantly affected the status of an established or nonestablished population, more frequent sampling will be scheduled. If such occurs, a study plan outlining the problem, objectives, methodologies, and product will be developed.

D. Itinerary.

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Main Diamond*	X	X	X		X		X		X
South Diamond	X	X	X		X		X	X	
McKenna		X						X	
Iron		X		X		X		X	
spruce	X		X		X		X		
Big Dry	X		X	X	X		X		
McKnight			X			X			X
E.F. Mogollon			X		X				
Sheep Corral			X				X		
Little			X			X			

*A special quarterly monitoring program for Main Diamond Creek will be followed for at least 3 years. This program is outlined in a separate document.

The above itinerary is subject to modification. However, to be successful, it should be adhered to with as much rigor as possible. **Other** streams will be added to this itinerary as they are reclaimed.

Appendix B

Public Review

The draft recovery plan was advertised in the Federal Register on July 2, 1992. A 60-day comment period was provided. Review copies were sent to Recovery Team members and consultants, affected agencies, institutions and individuals. Review copies were provided to other parties upon request. An asterisk (*) indicates those parties who submitted comments on the draft plan. Additionally, notices announcing availability of the draft recovery plan were published in the following newspapers: El Paso Times, Silver City Daily Record, Carlsbad Current Argus, Santa Fe New Mexican, Alamogordo News, and the Albuquerque Journal.

Copies Sent To:

Federal agencies

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Interested parties

* Michael Sauber, Conservation Chair, Southwestern New Mexico, Audubon
Society, Silver City, New Mexico
* Arne Leonard, Sierra Club Legal Defense Fund, Inc., Denver, Colorado

- Gus Van Allred, Jr., Vice President, Arizona/New Mexico Coalition of Counties, Glenwood, New Mexico
- * Susan Grinold, Silver City, New Mexico
 - Danny L. Fryar, County Manager, Catron County, Reserve, New Mexico
 - Luis Cardoza, County Manager, Grant County, Silver City, New Mexico
 - Charles R. Kearns, President, Gila Fish and Gun Club, Silver City, New Mexico
 - New Mexico Trout, Albuquerque, New Mexico
 - Dean Swanson, Southwestern Field Coordinator, Trout Unlimited, Wheatridge, Colorado
 - Jesus A. Flores, Vice Chair, Black Range Resource Conservation and Development, Inc., Deming, New Mexico
 - Allen D. Campbell, Gila Hotsprings Structural Steel, Silver City, New Mexico
 - David McCauley, Chairman, Grant County Soil and Water Conservation District, Silver City, New Mexico
 - Asa Barnes, Long Beach, California
 - Doc Campbell, Gila Hot Springs, Silver City, New Mexico
 - Dr. W.P. Stephens, President, Gila Mesa Association, Las Cruces, New Mexico
 - Samuel Acosta, Town of Silver City, Silver City, New Mexico
 - Joe Shirley, Chairman, Apache County Board of Supervisors, St. Johns, Arizona
 - Keith LeMay, Tourism Director, Silver City/Grant County Chamber of Commerce, Silver City, New Mexico
 - Don W. White, President, Silver City/Grant County Economic Development Corp., Silver City, New Mexico
 - Scott A. Crozier, Vice President and General Counsel, Phelps Dodge Corp., Phoenix, Arizona
 - Joe Burgess, Hidalgo County Commission, Lordsburg, New Mexico
 - M.H. Salmon, Gila Conservation Coalition, Silver City, New Mexico
 - Peter MacGill, Catron County Water Advisory Board, Reserve, New Mexico
 - Alex Thal, Southwest Center for Resource Analysis, Silver City, New Mexico
 - John Broenfield, Deming Soil and Water Conservation District, Deming, New Mexico
 - Dan Dunagan, Chairman, Southwest New Mexico Water Task Force, Silver City, New Mexico
 - Mike Lenton, Safford, Arizona
 - James W. Hartshorne, Southwest Association for Preservation and Utilization of Water Resources, Silver City, New Mexico
 - G.X. McSherry, New Mexico House of Representatives, Deming, New Mexico
 - Don R. Manzanares, Las Cruces, New Mexico

Copies Requested By:

- * Nancy Gordon, Silver City, New Mexico
 - Paul Friesema, Center for Urban Affairs and Policy Research, Northwestern University, Evanston, Illinois
 - Dr. James H. Baker, Manager, Ecological Services, ENSR Consulting and Engineering, Houston, Texas
 - Fred C. Schmidt, Head, Documents Department, The Libraries, Colorado State University, Fort Collins, Colorado



Peter D. McKone, Freese and Nichols, Inc., Fort Worth, Texas
 Barb Masinton, Special Status Species Coordinator Botanist, U.S.
 Department of the Interior, Bureau of Land Management, Santa Fe, New
 Mexico

- * Michael Bean, Chairman, Wildlife Program, Environmental Defense Fund,
 Washington, DC

Comments also Received From:

- * Thomas J. Dougherty, Staff Director, Western Region, National Wildlife
 Federation, Boulder, Colorado
- * Dr. Robert Ohmart, Center for Environmental studies, Arizona State
 University, Tempe, Arizona
- * Peg Edmister, Silver City, New Mexico
- * Patricia A. Danser, Deming, New Mexico
- * Luis I. Quiiiones, Mexicano/Chicano Chamber of Commerce, Silver City, New
 Mexico
- * Catherine I. Sandell, Las Cruces, New Mexico
- * Samuel M. Hitt, Director, Forest Guardians, Santa Fe, New Mexico
- * Trfcia White, Las Cruces, New Mexico
- * Billie Dreyfuss, Las Cruces, New Mexico
- * Jim Norton, Southwestern Regional Director, The Wilderness Society, Santa
 Fe, New Mexico
- * Ronald Smorynski, Las Cruces, New Mexico
- * Rick M. Billings, Vice President-Operations, Billings and Associates, Inc.,
 Albuquerque, New Mexico
- * Cecil and Mary Brown, Las Cruces, New Mexico
- * David Brower, Las Cruces, New Mexico
- Marcia Anderson, Las Cruces, New Mexico
- ☒ Ronald G. Pinnick, Las Cruces, New Mexico
- ☒ Don and Marlene Gutierreo, Silver City, New Mexico
- ☒ Paul Nachman, Las Cruces, New Mexico
- ☒ Steve Hill, Las Cruces, New Mexico

Appendix C

Comments Received

A total of 27 letters of **comment** were received on the draft revised Gila trout recovery plan. All personal letters **Of comment** are reproduced in this appendix. In addition, a petition signed by 55 individuals is also included. All comments were thoroughly reviewed and considered. Responses to comments **were** dealt with in two ways: (1) editorial comments, corrections, or factual errors were incorporated directly into the text of the plan; or (2) comments concerning plan content were addressed in specific responses, although similar comments were grouped together and answered as one. Specific U.S. Fish and Wildlife Service (Service) responses are in the section of the appendix following the reproduced letters of comment. Numbers in the margins of the letters refer to the appropriate response or responses for that comment. Comment letters are arranged in the **order** they were received by the Service.

Catherine I Sandell

8101 N. Main .
Las Cruces, NM 88001
23 July, 1992

Fowler-Propst 7/28/92
Donahoe
A. Cernato
Burton 7/28
A. Cull
B. Cull
C. Cull
Hamilton-McLean
Ward

RECEIVED
USFWS-AFO
7427
JUL 28 '92

Jennifer Fowler Propst
Field Supervisor, USFWS
3530 Pan Am Hwy N.E.
Albuquerque, NM 87017

Dear Ms. Propst,

The draft updated Gila Trout Recovery Plan released 9 July for public comment weakens and delays protection for the trout rather than providing stronger protection. Under USFWS "protection," approximately 80% of the total Gila Trout population has been lost in the past 3 years.

The current recovery plan is not adequate. The following items should be included in the updated plan:

Under "taking of Gila Trout," grazing must be considered as a human activity resulting in habitat changes that contribute to the decline of trout populations. As such an activity, grazing must be included in all monitoring programs and must be regulated accordingly in the draft plan.

Monitoring of Main and south Diamond Creeks is "coincidentally" not scheduled for the years that those riparian areas are grazed. These streams should be monitored in both grazed and ungrazed years to provide comparative data.

South Diamond Creek should be included in the special quarterly monitoring program outlined for Main Diamond Creek for the next three years, and a specific reintroduction plan outlined for Main Diamond Creek.

Black Canyon should be given priority as a reintroduction site. This stream was described last fall by USFWS as a "prime reintroduction site."

It is time to provide strong protection for the endangered Gila Trout even if this means reducing or removing cattle on a grazing allotment. Especially in a Wilderness Area, native wildlife should have priority over introduced exotics. It is disturbing that the agency responsible for the present and future condition of the nation's wilderness lands and its native wildlife, has abdicated that responsibility in favor of introduced exotics and collateral for bank loans.

It's time to consider native wildlife and habitat first instead of bank loans and bad economic decisions. The latter is no justification for degrading public land.

Thank you for your time.

Sincerely,

Catherine I. Sandell

Catherine I. Sandell



55 Valley Drive
Silver City, NM 88061
August 5, 1992

Jennifer Fowler Propst
Field Supervisor, USFWS
3530 PanAm Hwy. N.E.
Albuquerque, N.M. 87017

Dear Jennifer,

In regarding "Taking of Gila Trout", I encourage you to include the following in the updated plan:

1. 'Grazing results in **habitat** change and must be regulated
2. Creeks should be monitored in grazed and ungrazed areas to provide comparative data.
3. Black Canyon **should** be a prime reintroduction site for **Gila Trout**.
4. South **Diamond** Creek should be included in the monitoring program.

I have spent the past 15 years enjoying the **Gila** wilderness: hiking, backpacking and swimming In the rivers so I have experienced that "grazing results in habitat change."

Last week I hiked the west and middle forks of the **Gila**. There are many places where the wild flowers and other vegetation are shoulder high. This is not true of the East Fork where cattle are grazing and excreting waste. The river banks are damaged, the cow pies smell and the number of **insects** increases. It would be nicer to see more trout in our streams and less of the damage and annoyances of cattle. These animals should be on private ranches, not destroying **public** lands.

We, as the caretakers of the Earth, must begin making more drastic decisions to save wild places. As you must know, there are very few running streams in this area so please consider this carefully and make decisions that will protect the rivers and the wildlife in our forests.

Sincerely,

Peg Edmister

Peg Edmister

✓ Fowler-Propst
Denahoe 8/11/92
Adornato
✓ Burton 8/18
A. Culler
B. Culler
Gorreson
Hamilton-McLean
✓ Hanson 8-17
Mullins
Orms
Reehm
Roy
Shomo
Ward
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USFWS-AFO
8/11/92
AUG 10 1992

276 S. Nickel
Deming, NM 88030
August 9, 1992

Jennifer Fowler Propst
Field Supervisor - USFWS
3530 Pan Am Hwy. N.E.
Albuquerque, NM 87017

Dear Ms. Propst:

I would like to comment on the draft updated Gila Trout Recovery Plan released for public comment on July 9. Please include the following in the updated plan:

Under "taking of Gila Trout", grazing must be considered as a human activity resulting in habitat changes that contribute to the decline in trout populations. As such an activity, grazing must be included in all monitoring programs and must be regulated accordingly in the draft plan.

Monitoring of Main and South Diamond creeks is not scheduled for the years that those riparian areas are grazed. These streams should be monitored in both grazed and ungrazed years to provide comparative data.

South Diamond creek should be included in the special quarterly monitoring program outlined for Main Diamond creek for the next 3 years, and a specific reintroduction plan outlined for Main Diamond creek.

Black Canyon should be given priority as a reintroduction site. This stream was described last fall by USFWS as a "prime reintroduction site."

Thank you for this opportunity to comment.

Sincerely,

Patricia K. Danser
Patricia K. Danser

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Johnson	
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McIntosh	
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Moore	
Nease	
Reed	
Shaw	
Starnes	
Ward	
Wright	
Yoder	
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August 19, 1992

U.S. Fish and Wildlife Service
500 Gold Avenue, SW
Albuquerque, NM 87101-3152

Subject: **Gila** Trout Recovery Plan

U.S. Fish and Wildlife Service:

The authors of the **Gila** Trout Recovery Plan are to be commended for providing a comprehensive review of this species' ecology and historical population ranges. **Many** positive steps were presented for reducing its likelihood of extinction, such as the development of propagation techniques.

However, I would like to express some serious reservations about some of the methods proposed for extending the range of **Gila** trout and enhancing their habitat. One of the problems in developing recovery plans for a single species is that the plans become too narrow-focused, and the impact on other species does not receive sufficient attention.

10 The use of toxicants in streams is especially hazardous. No matter how **well** a **toxicant** is evaluated and no matter what precautions are taken, there is still a risk when it is introduced into water supplies upon which vegetation, wildlife and people depend. **There** was also no mention of the potential effect of piscicides on other native fish species. I am aware of a case in Idaho where a piscicide was applied to a lake to eliminate **trash** fish, but the toxin entered a watercourse and killed a large number of salmon - resulting in public outcry and reprimand of the State Fish and Game Department. A similar **hazard** exists here, such as the potential impact on other endangered fish species, particularly loach minnow and spokedace. Application of toxicants is not a sensible option in this era of concern about water quality degradation.

11 Stream habitat structures and the creation of additional pool habitat should **only** be done if compatible with the stream's geomorphology and biology. Blasting **and/or** alteration of waterfalls which represent an aesthetic resource should not be allowed. Some streams may never have had good pool habitat. Others **may** be in the process of **re-establishing** pools naturally following a flood, and in this case the process can be sped up by introducing artificial structures. Structures should be located and designed appropriately to minimize movement during floods and to reduce damage from scouring if they do move. If placed excessively or improperly, they can negatively impact the stream's balance between sediment movement and channel **form**.

12 Mention should also be given to the conclusion of **Nankervis (1988)** that stream structures built in Main Diamond Creek by the CCC in the 1930's had increased survival of **Gila** trout over drought periods - but that excessive placement of these structures had **also** resulted in **overpopulation** and stunting of the trout. These negative aspects of habitat improvements should be addressed in the recovery plan, such as their impacts on stream geomorphology and populations of other species such as benthic macroinvertebrates, as well as on **Gila** trout vigor.

13 With other endangered species, hybridization has been undertaken to preserve at least some of the genetic resource. According to the recovery plan, hybridized **rainbow/Gila** trout populations are thriving in some streams. Limited funds could be more effectively utilized by extending the range of **hybrid** populations - rather than **pure** populations - and leaving these streams open to fishing. Hybridized populations could be developed in hatcheries for transplanting, or pure and/or hybridized populations could be **translocated** from one stream to another. A limited period of restricted fishing (eg. lowered limits and/or catch and **release/barbless** hook) could be imposed until hybrid populations are established.

Extending the range of hybrid populations is preferable because:

1. **Preservation** of **Gila** trout in a large area is an unrealistic goal due to the risk of gene pool contamination. As long as floods and people have access to protected streams, the risk of rainbow trout introduction will exist. Maintenance of pure **Gila** trout populations would therefore require perpetual monitoring, sterilization of streams where rainbow trout had invaded, and re-stocking with **Gila** trout. The expense of this process could **only** be justified in highly inaccessible streams where risk of invasion is low.
2. Creation of "buffer zones" of hybrid trout downstream from pure **Gila** trout fisheries would reduce the risk of genetic contamination.
- 14 3. This is a compromise solution which would be more preferable to anglers than closing additional streams. Sports fisheries are scarce in the **Gila** National Forest, and many of the best ones are in the difficult-access areas which are most likely to be "restored" for **Gila** trout.

15 The recovery plan should also state that public notice and opportunity for comment **will** be required before any restoration streams are closed to fishing, current stocking practices discontinued, or other actions taken which affect current uses of the streams. The statement that the recovery plan would prohibit taking of **Gila** trout **anywhere** and eliminate stocking of non-native trout in potential habitat areas could lead to dramatic reductions in fishing opportunities. The popular (stocked) fisheries on the **Gila** River at Turkey Creek and on Willow Creek come to mind. An evaluation of the palatability of **Gila** trout should also be included in the discussion on sport fishing potential, **perhaps** by interviewing "old-timers".

16 A final question which I would like to see addressed in the recovery plan is the legal implication of landing a helicopter in a wilderness area for study or stocking of **Gila trout**.

In summary, I recommend that these changes be made to the recovery **plan**:

1. Eliminate the option of **blasting/altering** waterfalls.
2. Eliminate the option of using piscicides or other toxicants in streams.
3. Provide for public comment before actions are taken which would affect current uses of streams.
4. Consider a policy of maintaining **Gila** trout in the streams currently under protection and establishing hybridized **rainbow/Gila** trout fisheries downstream from these areas. The pure **Gila** trout streams would remain closed to fishing; the hybridized trout streams would remain open to fishing, possibly with a temporary period of restricted limits.
5. Recovery Plan Outline statement 1.4, related to discontinuing stocking and prohibiting the taking of **Gila** trout, should apply to designated "restoration" streams only, not in general or to "potential or actual habitat".

6. In the design of stream habitat improvement structures, consider geomorphologic and hydraulic factors and potential impact on resident species (eg. plants, invertebrates, amphibians, other fish) as well as on **Gila** trout.
7. Address the use of helicopters in wilderness areas.
8. Address the acceptability of **Gila** trout as a sport fish.

Thank you for providing the opportunity for public comment on the recovery plan.

Sincerely,

Nancy Gordon

Nancy Gordon
Hydrologist; **Flyfisher**
P.O. Box 1274
Silver City, NM 88062

cc: NM Ecological Services **Field** Office
3530 Pan American Highway, **NE**, Suite D,
Albuquerque, NM 87107

GOVERNOR
Bruce King



DIRECTOR AND SECRETARY
TO THE COMMISSION
Bill Montoya

STATE OF NEW MEXICO
DEPARTMENT OF GAME & FISH

Villagra Building
P.O. Box 25112
Santa Fe, N.M. 87504

STATE GAME COMMISS
JAMES H. (JAMIE) KOCH, CHA
SANTAFE

THOMAS P. ARVAS, O.O., VICE-C
ALBUQUERQUE

BOB JONES
CROW FLATS

J.W. "JOHNNY" JONES
ALBUQUERQUE

BRUCE WILSON
MESILLA PARK

DAVID M. SALMAN
LA CUEVA

ANDREA MAES CHAVEZ
NAVAJO DAM

August 24, 1992

Mrs. Jennifer Fowler-Propst
U.S. Fish and Wildlife Service
3530 Pan American Highway, NE
Suite D
Albuquerque, New Mexico 87107

Dear Mrs. **Fowler-Propst**:

Thank you for the opportunity to review the draft **Gila** Trout Recovery Plan. The document provides a comprehensive overview of the status and biology of the **Gila** trout as well as an informative narrative of recovery efforts to date. Most comments the department has relate to clarification and more precisely presenting certain information. These comments are on the attached copy of the recovery plan. As indicated on the attached draft, reorganizing the section on status and recovery actions to date (pp. 11-13) would improve clarity. In addition, the following suggestions/comments should be considered.

In Part II (Recovery, p. 33), Item 2.1.1 calls for evaluation of the effect of sport fishing on populations of **Gila** trout. We believe placement of this action within the context of re-establishing **Gila** trout within historic range is inappropriate. Rather, this work should be a separate action item and should occur after downlisting.

As stated, Item 3.2 (page 34) seems to call for combining the San Francisco and **Gila** lineages of **Gila** trout. Given the genetic distinctiveness of the Spruce Creek population (the only known San Francisco drainage population), we do not believe it is appropriate to mix the San Francisco River form with the **Gila** River form. Certainly, consideration should be given to mixing the upper **Gila** drainage forms.

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Mrs. Jennifer Fowler-Propst

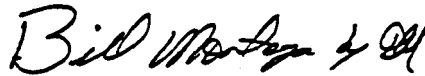
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August 24, 1992

We appreciate the considerable effort to develop this revision of the **Gila** Trout Recovery Plan. The department remains committed to restoration of the species and believes this plan provides a comprehensive plan to achieve this goal.

Again, thank you for the opportunity to comment upon this revision of the **Gila** Trout Recovery Plan.

Sincerely,

A handwritten signature in black ink, appearing to read "Bill Montoya" followed by a stylized flourish or set of initials.

Bill Montoya
Director

BM/dlp/ap

Att.

cc: Daniel **H.** Sutcliffe
Stephen E. Henry
David **L. Propst**

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✓
5493 Clavel
Las Cruces, NM 88005
August 26, 1992
File

Jennifer Fowler Propst
Field Supervisor
USFWS
3530 Pan Am Hwy. N.E.
Albuquerque, NM 87017

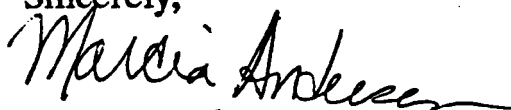
Dear Ms. Propst,

I am writing to comment on the draft updated Gila Trout Recovery Plan released by your office on July 9th. I do not feel the plan protects the trout adequately from cattle activity.

Under "taking of the Gila Trout" you must consider grazing as a human enterprise that results in habitat modification and degradation. As such, grazing must be monitored, regulated and modified so that it does not threaten the trout habitat. I feel that the only way to do this is to reduce grazing in the Gila Watershed. The weight of cattle grazing and drinking in the Gila watershed streams has caused streambanks to cave in. Vegetation which had stabilized these banks has either been destroyed or eaten. Thus the streams have become wider and shallower. This along with reduced shade, leads to higher water temperatures. Thus the trout habitat is degraded.

The problems of the riparian zones due to overgrazing cannot be solved by constructing stock tanks in upland pastures and moving the cattle there. Grazing in these pastures will alter the ecology of the higher reaches of the streams, leading to continued stress on the watershed system. If we want the Gila Trout to recover, we must reduce the grazing in the Gila Watershed.

Sincerely,



Marcia Anderson

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✓ 7/1/92
2615 Mesilla Hills Dr.

Las Cruces, NM 88005

August 26, 1992

Jennifer Fowler Propst
Field Supervisor
USFWS
3530 Pan Am Hwy. N.E.
Albuquerque, NM 87017

Dear Ms. Propst,

We are writing about the draft updated Gila Trout Recovery Plan. We feel that the plan is inadequate, especially since it omits potential reintroduction sites discussed in the 1984 recovery plan and fails to propose adequate measures to protect the Gila Trout habitat from cattle activity.

We are concerned that grazing on the Diamond Bar Allotment will doom the Gila Trout recovery plan to failure. As you know, the Diamond Bar Allotment consists of 145,000 acres of National Forest, 121,000 of which is in the Gila and Aldo Leopold Wildernesses. By now it is obvious that grazing on the Diamond Bar Allotment has degraded the Gila Watershed--the habitat of the Gila Trout. In the Las Cruces Sun-News (16 August 1992, p. A4), Arizona State University zoology Professor Robert Ohmart, an expert on riparian zones, called the Upper Black Canyon Creek "one of the worst degraded streams I have ever seen." Because of the increasingly obvious and publicized damage to the riparian zones in the Gila watershed, pressure is building to reduce the cattle presence there. But how can this be done while continuing to graze over 1000 cattle on this forest land and wilderness allotment? The Forest Service is proposing that stock tanks be constructed with bulldozers in wilderness high pastures.

We feel that the Gila Trout Recovery Plan should oppose the construction of stock tanks in the upper reaches of wilderness streams in the Gila Watershed. Instead we need to reduce the number of cattle grazed on this allotment. The health of the riparian zone depends on the health of its watershed. Increased grazing in the upland areas will lead to loss of vegetation and compaction of soils in those areas. This in turn will lead to greater runoff and sedimentation of downstream waters. In addition,

construction of stock tanks in the higher elevation pastures will introduce cattle into an area formerly reserved for elk, deer and other wildlife. We do not feel this is appropriate in a wilderness area. What is really needed is reduced grazing on the Diamond Bar Allotment. This should be one

- 8 findings, conclusions and recommendations the Gila Trout Recovery Plan.

Sincerely,

Will Brown

Mary Brown

Thankful for ^{study} your, contemplation, + energy in
behalf of the well fare of this earth & its people.
Thanks. —

✓ 9/3 ✓

73

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File

Jennifer Fouler Propst
Field Supervisor
USFWS
3530 Pan Am Highway NE
Albuquerque, NM 87017

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_____ Fowler-Prop
 _____ Donahoe
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 _____ Burton
 _____ A. Gill-
 _____ Gill
 _____ Garrison
 _____ Laughlin
 _____ Harney
 _____ Phillips
 _____ Crane
 _____ Smith-
 _____ Crane
 _____ Shomo
 _____ citizen ward

The purpose of this letter is to state my dissatisfaction with the draft **Gila** Trout Recovery Plan updated July 9, 1992. -

It is time to get cattle out of wilderness areas. As a US citizen ward
I am a joint owner of the lands owned by the US government (National-: _____
Forests, Wilderness Lands and BLM lands). I am very tired of these _____
8 lands being managed in a way that shows a very marked preference for a file
relatively small number of people (e.g., cattlemen). One rancher is
1 damaging 145,000 acres; 85 percent of this is in wilderness areas.

In deciding how to manage our resources we must ask: Who benefits, and who pays? If you were to ask residents throughout the New Mexico and citizens throughout the US if they would prefer to have more cattle in the **Gila** or more **Gila** trout, more elk and more deer, can you imagine that even 20 percent would say they would prefer more cattle? I cannot. There are many, many people who benefit from getting cattle out of the **Gila** wilderness: hunters, fishers, hikers. There are few who benefit from having cattle there (it is primarily one ranching company). If our tax dollars are to be used to provide welfare for ranchers (or the big holding companies who own so many of the grazing allotments) I'd prefer that these tax monies at least go for **some things that** does not ruin the environment. **Our** tax monies should go for monitoring the environment, monitoring the number of cattle and their effects and for keeping the excess out.

Sincerely,

Ston Hill

Steve Hill

4010 B Oleta Dr.
Las Cruces, NM 88001

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August 25, 1992

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Jennifer Fowler-Propst
Field Supervisor
New Mexico Ecological Services Field Office
u. s. Fish & Wildlife Service
3530 Pan American Hwy NE
Albuquerque, NM 87107

Dear Jennifer,


I am deeply dismayed at the draft updated **Gila** Trout Recovery Plan which you sent out for public comment on July 10, 1992. In **its** omission of the impacts of livestock grazing, this new draft plan falls short of addressing both the major reason for the decline of the **Gila** Trout and the necessary measures in any real recovery strategy. In fact, the new draft represents a pitiful attempt by an agency effectively 'cowed' by the cattle industry, to **mitigate losses** and delay extinction - by moving fish to streams outside their native range and to hatcheries - while ignoring the major cause of decline: severe, prolonged overgrazing of the watersheds and riparian areas along the streams within the **Gila** Trout's **native** range.

The draft instead focuses on competition from, and hybridization with non-native, introduced trout. It says nothing **of** the **miles and miles** of once perennial streams which are now intermittent or completely dry. Has your agency investigated the causes of stream dewatering, or how many miles of habitat have been lost? Main Diamond and South Diamond are now dry much **of** the year. Most of the riparian habitat is completely absent, and the uplands are a mosaic of bare soil, rabbit brush and weedy annuals for miles and miles. Yet when I spoke with Jerry Burton this week he "**didn't** realize" that the monitoring program outlined for this area **very** coincidentally is scheduled for only the ungrazed years.

3 The draft plan mentions "industrial **waste**" as a cause **of** stream pollution. True, raising cattle is a huge industry in this area, but why not come forth and say 'fecal debris from cattle'? Black Canyon is choked with algae - very unbecoming for a high-quality cold water wilderness stream, and no doubt annoying to trout on the brink of extirpation. This warm, shallow water, this stream devoid of riparian vegetation, with eroding, cut banks, was described to me last fall by Mr Burton as "**a** prime reintroduction **site**". And it could be, if cattle were removed. Yet this year the Forest Service extended the grazing season in this pasture - for 915 **cattle** (and 600-700 calves).

I was appalled when I spoke with Jerry and he attributed the degradation of these areas **to Aldo** Leopold and his deer preserve almost a century ago. Yes, deer in huge numbers do significant damage (and **Aldo** was astute enough to recognize this and rectify it). But what about now? If deer did all this damage and the cattle are fine and dandy, then where are the young trees? Where is the stream cover, the **grass**, the pool habitat and the fish?

Your agency must take a stand on this. A growing number of the public is becoming aware that Fish and Wildlife Service is simply not doing its job. To spend two million dollars on stop gap recovery efforts while ignoring the cause for the decline and the obstacle **to recovery** is an incredible waste of **the** U.S. taxpayers' **money**. And I am becoming annoyed at my tax dollars paying the salaries **of** federal employees who can't (or won't) see their hand in front of their face. Meanwhile, **the** rest of us can't see the forest for the cows!

Sincerely 
Susan Schock-Grinold

strategy"), and (2) "expansion of current distribution of **Gila** trout within its historic range into larger, more stable, resilient habitats" ("the expansion strategy"). Given the draft plan's admission that the preservation strategy "would not decrease the likelihood of local extinction by natural events," it is difficult to understand how such a strategy could be construed as meeting the plan's goal. There is already plenty of evidence that the preservation strategy ~~has~~ failed. Reports indicate that approximately 80% of the ~~total~~ **Gila** trout population has been lost in the past three years, with the loss or near-loss of between three and five populations of **Gila** trout occurring in less than one year. (See, for example, the article on "**Conservation and Status of Gila Trout**" in the June 1992 issue of The Southwestern Naturalist.) Clearly, small headwater streams do not provide habitat that is secure enough to meet the goal of the draft plan.

The expansion strategy is the only strategy identified in the draft plan which could achieve the plan's goal. Management actions necessary to carry out this strategy are not described in the site-specific manner required by the Endangered Species Act, **however**. For example, the draft plan fails to identify any of the "larger, more stable, resilient habitats" into which **Gila** trout are to be reintroduced. In order to meet the requirements of the Endangered Species Act, the recovery plan needs to identify specific reintroduction sites, include specific measures needed to restore each site to the point where it can provide suitable habitat for **Gila** trout, and set a date for completing reintroduction at each site. Merely mentioning plans to select reintroduction sites in the indefinite future is not acceptable, especially considering that more than twelve years have passed since the first **Gila** trout recovery plan was issued. After twelve years of study, the recovery team should have some specific locations in mind for reintroduction sites.

Potential reintroduction sites were specified in the 1984 recovery plan: these sites should be considered in the new plan. In particular, the recovery plan should call for the reintroduction of **Gila** trout in the Black Canyon area of the **Aldo** Leopold wilderness. This area, which contains the last perennial stream in the Black Range, was described by your agency as a "prime reintroduction site" last Fall.

Measures needed to restore and expand **Gila** trout habitat in Main **Diamond** and South Diamond Creeks also should be described in the recovery plan. The discussion of such measures should be prefaced by a detailed and critical account of the loss of the Main Diamond and South Diamond Creek populations of **Gila** trout.

August 25, 1992

Page 3

Such an account needs to mention that, while the Forest Service
30 **reported** losing only one fish during the Divide Fire evacuation,
most of the fish were subsequently lost before they could be
transplanted.

This loss suggests that hatcheries provide no safer refuge
than the **"highly** variable, widely fluctuating headwater
environments" which **Gila** trout currently **occupy**. Fish held in
hatcheries are vulnerable to predation and human-caused
operational errors which can extirpate a large concentration of
fish in a very short period of time. A recovery plan which keeps
23 most of the reproducing **Gila** trout population in hatcheries
cannot be relied upon to recover the species. Delisting will
only come by preserving and restoring the species' original
habitat.

The draft plan seems to conclude that habitat destruction is
a random event brought about by natural disasters such as floods,
fires and drought. Nowhere does the draft plan address the
habitat destruction caused by the water diversions, soil
compaction, erosion and denuding of riparian vegetation
associated with livestock grazing. Studies have shown that these
32 effects of livestock grazing destroy a stream's assimilative
capacity to such an extent that it cannot recover promptly from
floods, fires and droughts. (See, for example, **the** widely
available report on "Livestock Grazing on Western Riparian **Areas**"
produced for the EPA in July, 1990). It is misleading to
attribute habitat loss to random, natural events when the adverse
effects of such events are so heavily aggravated by deliberate,
human-caused activities. Discussion of the habitat destruction
induced by livestock grazing should be discussed **thoroughly under**
"Reasons for Decline" (p. 9), and **"Factors** affecting population
persistence'* (p. 26). Placing restrictions on livestock grazing
should be discussed under the task of regulating adverse human
activities (p. 35). When formulating restrictions on livestock
grazing, it is important to keep in mind that livestock-induced
deterioration of uplands, **as well** as riparian areas, contributes
to **the destruction** of stream habitat.

In addition to failing to describe management actions in a
site-specific manner, the draft plan fails to provide objective,
measurable criteria for determining when the **Gila** trout can be
delisted. The draft plan states that **"[d]elisting** criteria
31 cannot be addressed at present, but will be determined when
downlisting criteria are met." No rationale for omitting the
delisting criteria is given in the draft plan, and such an
omission does not meet the requirements of the Endangered Species
Act.

Furthermore, the criteria for downlisting contained in the draft **plan** are not objective or measurable. The criterion which calls for downlisting "**when** all known indigenous lineages are replicated in the **wild**" contains no operational definition of what it means to "**replicate**" an indigenous lineage in the wild. 33 The criterion which calls for downlisting when **Gila** trout are "established in a sufficient number of drainages such that no natural or man-caused event may eliminate a lineage" does not specify how many or what type of drainages constitute a "**sufficient** number" to prevent the elimination of a lineage.

The vagueness and incompleteness of the draft plan's downlisting criteria also plague the time and cost estimates 34 contained in the draft plan's implementation schedule. For example, under task 1.42, the only prohibitions on the taking of **Gila** trout involve prohibitions on fishing. The task of prohibiting livestock grazing in and around streams inhabited by **Gila** trout is omitted completely. It is hard to believe that the draft plan budgets money to post signs declaring waters closed to fishing, but doesn't set aside a single penny for the task of keeping livestock away from such waters.

The draft plan's implementation schedule also 'does not seem to budget any money for the "**evacuations**, temporary holding measures, transplants, and extensive habitat manipulation" 35 required to preserve populations of **Gila** trout in small headwater streams. Presumably, such measures would fall under the tasks of holding and propagating **Gila** trout in a hatchery. This task, already the largest item on the budget for the draft plan, could become even more expensive if it is to include the enormous costs of responding to emergency situations such as the Divide Fire.

The relatively large amount of funds set aside for holding **Gila** trout in a hatchery suggests a policy which favors **hatchery-**based recovery efforts in which fish are continually stocked from an artificial environment to marginal stream habitats where little or no recruitment occurs. Overreliance on hatcheries is 23 undesirable from an ecological perspective, and may be economically undesirable as well if the high costs of evacuations and other emergency measures are weighed against the costs of preventing such emergencies by implementing an expansion strategy to restore larger, more stable habitats.

While the draft plan states that the expansion strategy is "preferred," this preference is not evident in the draft plan's budget. Indeed, the draft plan's failure to commit sufficient 36 resources to the expansion strategy proves that this strategy is merely a "**second** priority." Relegating the expansion strategy to

...

August 25, 1992

Page 5

a **"second priority"** is inconsistent with the statement that this strategy is **"preferred."** This inconsistency should be resolved by adjusting the plan's priorities to match its preferences.

37 The draft **plan's** assertion that **"[p]opulations of Gila trout,** and its habitat will continue to be maintained and improved" is quite perplexing. Since existing recovery efforts have neither improved nor maintained the status of the **Gila trout** in the first place, it is hard to understand how such efforts could **"continue"** to maintain and improve the trout's status. It is even harder to understand how such a failed strategy could be given top priority in the recovery plan. Recently published studies of the **Gila trout**, such as the Southwestern Naturalist article cited above, indicate that existing recovery efforts need to be thoroughly reevaluated. The draft plan does not provide such a thorough reevaluation. Instead, it merely calls for a continuation of the status quo.

While there are many obstacles preventing efforts to recover the **Gila trout**, making the changes necessary to overcome these obstacles is not a hopeless task. Our criticisms of existing recovery efforts certainly-are not intended to suggest that recovery of the **Gila trout** is a waste of **resources**. On the contrary, our review of the draft plan leads us to conclude that not enough resources are being committed to **Gila trout** recovery efforts. Underlying this conclusion are some basic assumptions that we share with the authors of the draft plan, i.e., the **Gila trout** is a valuable component of the native fauna and recovery of the species is essential to the task of maintaining biological diversity.

We look forward to receiving a copy of the revised version of the recovery plan with the expectation that the revised plan will incorporate the changes we recommend. Thank you for giving us the opportunity to comment on the draft plan.

Sincerely,

Arne Leonard

Arne Leonard
Rocky Mountain Office

cc: **Gila Watch**
Sierra Club
The Wilderness Society
Biodiversity Legal Foundation

Arizona State University

Center for Environmental Studies

Tempe AZ 85287-3211

18 August 1992

Michael Spear, Regional Director
U.S. Fish and Wildlife Service
Federal Building
517 Gold Avenue SW
Albuquerque NM 87103

Dear Mike:

9/4/92

Fowler-Probst	
Donahoe	
Cernoni	
Brown	
Harrison-Miller	
Hansen	
Mullins	
Orms	
Recher	
Soy	
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- 1 I have reviewed the 1992 Draft Recovery Plan for the **Gila** trout and was appalled that the Plan did not address the severe degradation of the streams by domestic livestock grazing. The Plan states there has been "changes in stream condition." Dr. Miller (1950, 1961) plainly states the causes (see photocopied page) and I have observed them as well. Both the spikedace and loach minnow recovery plans address the cattle grazing problem and call for cessation of overgrazing. Why the lack of consistency? Trout are much more subject to overgrazing, but the Recovery Plan does not call for improved grazing management practices. I certainly hope the U.S. Fish and Wildlife Service isn't submitting to the U.S. Forest Service and plans to do nothing regarding this issue. **Riparian** trees no **longer** line much of the streams to provide shade and organic input. Overhanging banks are long gone to provide trout cover, most streams are entrenched and carry heavy sediment burdens. Native trout can never be recovered until improved grazing practices are undertaken by the U.S. Forest Service. Have these issues been discussed under Section 7 Consultation?
- 38

New Mexico Game and Fish expended close to \$2 million for hatchery plantings last year. On most of the **Gila** River this money was wasted since most of the trout habitat is so degraded that oxygen levels and sediment loads are marginal for even their survival. Hybridization will be a problem as stated in the **Recovery** Plan but one needs not worry about that if the habitat is so degraded that it won't even support implants.

- 1 If grazing management practices are to be changed on this allotment, and **Gila** trout are ever to be recovered, it will only come about by forcing the U.S. Forest **Service** to quit submitting to the **cattle** growers. By **not** addressing these issues in the Recovery Plan makes it appear that the U.S. Fish and Wildlife Service either does not understand the problem or is subservient to the U.S. Forest Service. Public pressure and concern is already being applied to this problem on this allotment and I hope the U.S. Fish and Wildlife Service will spearhead the effort in their Recovery Plan.

Sorry to hear you are leaving the Region. Best of luck.

Sincerely yours,

Bob

Robert D. Ohmart, Ph.D.

RDO/cdz

Encl.

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SEP 03 '92

427 Dartmouth Apt B
Las Cruces 88005
30 August, 1992 ✓

J. Propst
USFWS
3530 Pan Am Hwy
Albuquerque 87017

Dear Ms. Propst;

I understand that the Forest Service is up to its usual chicanery in the Leopold & Gila Wilderness Areas, proposing to put in further cattle-oriented developments in places that, according to the 1964 Wilderness Act, must be left "untrammeled by man." One of the Gila Forest's indicator species, the Gila trout, is already Endangered and will be put further at risk by increasing the number of grazing cattle.

However, if USFWS shows some spine in protecting the trout, further development and further cattle will be kept out of these wilderness areas. It's time USFWS took the steps that will favor trout survival and ecosystem restoration.

Sincerely,


Paul Mackman

Paul Mackman

[illegible]

Jennifer Fowler Probst
Field Supervisor
USFWS
3030 San Antonio N.E.
Albuquerque, NM 87017

I have lived in Las Cruces for 15 years and have enjoyed camping, fishing and hiking in the Gila Wilderness many times. However, there seems to be a lack of wildlife in the wilderness but no such lack of cattle. I believe that the Gila is overgrazed and the streambeds denuded by these cattle. I understand that the Gila trout population is being threatened and I urge you, as representative of the Forest Service, to reduce significantly the number of grazing cattle on these lands.


Ronald G. Pinnick
1019 Cedarvale
Las Cruces, NM 88001

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USFWS-AFO
40319061
SEP 03 '92

✓
Don and Marlene Gutierrez
2404 Swarthmore Drive
Silver City N.M. 88061

Jennifer Fowler Probst
Field Supervisor USFWS
3530 Pan AM HWY N.E.
Alb. N.M. 87017

Dear Ms. Probst:

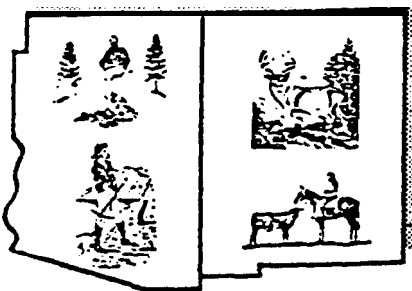
1 We urge more stringent conserva-
tion of the Gila now. Grazing must
be curtailed, ^{since} ~~as~~ cattle as food is no
longer a viable option in a world ex-
ploding with humans and undergoing
a devastation of its environment.

5 Specifically, there must be monitor-
ing of Main and South Diamond Creeks,
and Black Canyon must be reintro-
duced as a site in the new plan.

Sorry to get this letter in so
late, but I am recovering from surgery.
mcs

Sincerely,

Ronald K. and Marlene C.
Gutierrez



"Working together for responsible management."

Coalition Of ARIZONA/ NEW MEXICO COUNTIES FOR STABLE ECONOMIC GROWTH.

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9/1/92
SEP 09 '92

September 2, 1992

Jennifer Fowler-Propst

Field Supervisor

New Mexico Ecological Services Field Office

3530 Pan American Highway, NE

Albuquerque, NM 87107

RE: Draft Recovery Plan for the Gila Trout.

Dear Mrs. Fowler-Propst,

The following comments are being submitted by the Arizona counties Apache, Gila, Graham, Greenlee and Navajo and the New Mexico counties Catron, Eddy, Hidalgo, Lincoln, Luna, Sierra, Socorro and Torrance as members Of the Arizona/New Mexico Coalition of Counties (Coalition). These counties have combined populations of 336,380. The Coalition also has additional membership from statewide organizations and industries in both states representing over 60,000 individuals.

We have reviewed the Draft recovery plan for the Gila Trout. Our technical writer, Howard Hutchinson, contacted your office on August 31, 1992, to clarify the level of comment that was requested. Mr. Jerry Burton suggested we file our comment even though it would be past the indicated comment period ending on August 31.

We were forwarded the request for comment from Mr. Danny Fryar, County Manager for Catron County. There was no indication in the letter if this was a proposed promulgation of a rule. If it is, there was no summation of the Federal Register Notice.

Catron County has in place an Interim Land Use Policy Plan as do other member counties that request notification of proposed federal agency actions. While we do not perceive any major conflicts between Catron County's Plan and the Recovery Plan there is no mention of having reviewed the plan in your notice. Catron County has recently hired a wildlife biologist to begin developing county-generated recovery plans for endangered species. The object of this action is to have a greater role developing and implementation of recovery plans. We request that you contact Mr. Wray Schildknecht through the Catron County Commission office to establish coordination for recovery planning. We believe you will find that there is a genuine interest on the part of Catron County and the Coalition to proceed with coordinated efforts to recover endangered and threatened species to the desired downlisting and delisting.

Our comments on the plan, specifically are:

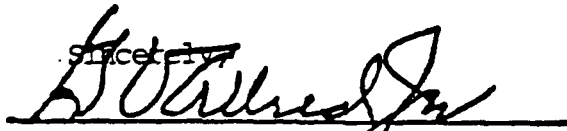
- 1) There is a lack of detail in the methods and locations of prescribed burn or other vegetative management to modify wilderness habitat. We would like to draw your attention to the paper Changes in Forest Conditions and Multiresource Yields from Ponderosa Pine Forests Since European Settlement: by Professor W. Wallace

Covington and Assistant Professor Margaret M. Moore, Northern Arizona University School of Forestry, November, 1990 - revised February, 1991. According to this paper, the Gila watershed, along with possibly the Arizona historic habitat of the Gila Trout, is seriously fuel loaded and has increased vegetative density that is directly affecting water delivery to the upper and lower elevation riparian system. The adverse impact on the riparian systems is coupled with immediate danger of "climax fire visits" such as the Divide Fire that impacted the Diamond Creek population.

40 2) Catron County's Land Plan and inclusive Water Plan directs attention to Pinon/Juniper (P/J) invasion of lower and upper elevation grasslands. This is also addressed to some extent in Professor Covington's paper. The reduction of in stream flows on many Gila and San Francisco river tributaries contributes to higher water temperatures. Another impact that has resulted from the P/J invasion is sheet erosion increasing siltation and water turbidity. We would like to see mitigation plans for P/J invasion in the recovery plan.

3) Lower precipitation levels for the indicator years of Gila Trout populations declines cited in the recovery plan should be a consideration. If what records indicate are true, we will be in a wet cycle for a number of years. This is an opportune period to accomplish recovery.

4) The letter of the law in the 1978, 79 and 82 amendments exempts the Gila Trout's designation as Threatened or endangered in regards to declaration of critical habitat. However, the Fish and Wildlife Service is pressing the limit of congressional intent in expanding the reach of recovery activity without the prerequisite public and local government notification and input. Any major alterations in the scope of recovery will require amending the Gila National Forest Plan. We will be monitoring Forest activity and are prepared to comment on any amendment that leaves the boundaries of the Gila Wilderness area or adversely impacts other forest activities such as timber harvesting or grazing. Since there is no mention of curtailing these activities in the recovery plan, we reserve comment at this time.

Sincerely,


Guss Van Allred, Jr.
Vice-President, Coalition of
Arizona/New Mexico Counties

xc: Maynard Rost, Supervisor, Gila National Forest; Regional Director, U.S. Fish and Wildlife Service, Albuquerque



NATIONAL WILDLIFE FEDERATION

Rocky Mountain Natural Resources Clinic
Box 401, Fleming Law Building, Boulder, CO 80309

303/492-6552
303/492-2118 (fax)

September 11, 1992

John F. Turner, Jr., Director
United States Fish and Wildlife Service
Washington, D.C. 20240

Re: Draft Gila Trout Recovery Plan — Gila National Forest, New Mexico

Dear John:

In conjunction with several colleagues, I recently reviewed the Draft Gila Trout Recovery Plan (the "Plan"), a copy of which is enclosed for your convenience. This Plan is supposed to provide guidance for restoring Gila Trout populations in the Gila National Forest in New Mexico. As you know, Gila Trout recovery efforts were dealt a catastrophic setback by a forest fire in 1989.¹ Unfortunately, during our review of the current draft Plan we were shocked by some of the draft's omissions, and write in hopes that legitimate biology will be resurrected before the Plan appears in final form.

Our principal concern is the Plan's failure to even mention, much less discuss, the effects of cattle grazing upon Gila Trout recovery efforts. This omission is particularly glaring in light of the Plan's admission that habitat degradation is a principle reason for the decline of the Gila Trout (the Plan p.9) and the overwhelming evidence that cattle grazing is largely responsible for this degradation.

Rather than discuss cattle grazing, the Plan misleadingly implies random fires, floods, and droughts are solely responsible for the degradation of the Gila Trout's habitat. This conclusion ignores the fact that the Gila Trout has coexisted with fires, floods, and droughts for thousands of years. Although these natural events, like the 1989 Divide Fire, certainly affect the Trout, many are persuaded it is the destruction of riparian vegetation caused by over-grazing which is principally responsible for the current decline in acceptable Gila Trout habitat.

In fact, not only does cattle grazing directly degrade the quality of Gila Trout habitat through soil compaction, erosion and denuding of riparian vegetation, it also dramatically increases the severity of the very fires, floods, and droughts the Plan recognizes are a problem. The adverse impacts of cattle grazing

¹ The Divide Fire destroyed the entire Gila trout population in Main Diamond Creek, previously considered to be "the most stable, secure population of Gila trout." The Plan p.10.

on the riparian areas essential to the Gila Trout are well documented. For example:

- The New Mexico Environment Department has concluded "historical grazing practices in the watershed have contributed to reduction of riparian vegetation which in turn resulted in bank destabilization. As a direct [sic] result, water pollution including elevated temperatures (i.e., lack of shading), increased suspended sediment load, turbidity and organic loading are occurring."²
- The New Mexico Department of Game and Fish has also concluded "[h]abitat degradation possibly due to recent increases in the number of livestock has been observed in riparian and upland areas on the Diamond Bar allotment."³ The number of livestock currently being grazed is having a profound impact on terrestrial and aquatic wildlife habitat."

In ignoring the effects of cattle grazing on Gila Trout recovery efforts, the Plan not only contradicts the conclusions of the authorities discussed above, but the prior conclusions of United States Fish and Wildlife Service (USFWS). For instance, the prior version of the Gila Trout Recovery Plan prepared in 1978, and last revised in 1983, stated in the section entitled "Conservation Efforts and Protective Measures" that "[l]ivestock grazing in the watersheds of other streams in New Mexico that contain [Gila Trout] is either prohibited or closely regulated."⁴

41 Additionally, the plan for recovering the endangered Loach Minnow, which lives in many of the same drainages as the Gila Trout, recognizes "[l]ivestock grazing that results in widespread removal of covering grasses and shrubs from the watershed, or denuding of riparian vegetation, may induce dramatic changes in precipitation runoff, suspended sediment, and bedload that increase stream turbidity, clog interstitial spaces of coarse substrates, and enhance erosion of

² Letter from Jim Piatt, Chief Surface Water Quality Bureau, State of New Mexico Environment Department to Gerald Engel, District Ranger Mimbres Banger District, August 12, 1992. Letter attached as Exhibit A

³ The Diamond Bar allotment is the cattle grazing allotment which covers a large part of the current habitat used by the Gila Trout. The allotment is located almost exclusively within two wilderness areas (the Gila and Aldo Leopold) and is the largest allotment in New Mexico.

⁴ Letter from Bill Montoya, Director New Mexico Department of Game and Fish to Gerry Engel, District Banger Mimbres Banger District, May 20, 1991. Letter attached as Exhibit B.

⁵ Gila Trout Recovery Plan June 20, 1978, revised December, 1983, p.15.


stream channels and **banks**."⁶ Moreover, in commenting on the **draft** Integrated **Resource Management Analysis** prepared by the U.S. Forest Service for the Diamond Bar Allotment, USFWS recognized that "[e]limination of grazing, east of Forest Road 61, will greatly benefit **Gila trout recovery efforts** . . .".⁷

1 Accordingly, I believe that to honestly chart the recovery of the **Gila Trout**, the Plan must be amended to discuss livestock grazing under "Reasons for Decline" (p.9), and "Factors **affecting** population persistence" (p.26). **More** importantly, placing restrictions on livestock grazing should be addressed in the **discussion** of adverse human activities which should be regulated (p.35).

John, I call **this** issue to your attention because we have been contacted by several local and regional **conservation** organizations who have submitted comments to the Plan (comment period closed August **31, 1992**), but are not encouraged that their concerns **will** be addressed in the **final plan**. These conservation groups almost unanimously suspect that the continued failure of the Plan, even this late in the planing process, to discuss grazing impacts appears to be a calculated omission rather than an over-sight.

Perhaps there is more to this story than I am aware, but John, NWF **and** the USFWS have a very good working relationship and I don't want to be required to dedicate our scare human resources to an issue that could and should be resolved in the planing process. We are deeply concerned not only with regard to the **Gila Trout**, but with the very fragile and important fish and wildlife resources in the **Gila Trout** recovery area. I would be happy to talk with you and your **staff** about this matter.

Sincerely,



Thomas J. Dougherty
National Wildlife
Federation Western **Regional**
Staff Director

JT:pcy

⁶ Loach Minnow (*tiaroga cobitis*) Recovery Plan prepared by **Paul Marsh** issued USFWS, Phoenix, September, 1991, p. 7.

⁷ **Letter from** Gerald Burton, Field Supervisor USFWS to Gerald A **Engel**, District Ranger, **Mimbres** Ranger District, May **13, 1991**. Letter Attached as Exhibit C.

✓
RECEIVED
U.S. FISH & WILDERNESS SERVICE

SEP 14 1992 9/14/92

1810 Mulberry -
Las Cruces, NM 88001

August 26, 1992

9/18

Jennifer Fowler Propst
Field Supervisor
USFWS
3530 Pan Am Hwy. N.E.
Albuquerque, NM 87017

Dear Ms. Propst,

- I am writing to comment on the draft updated Gila Trout Recovery Plan your office released on July 9th. How can you even think about the Gila Trout recovering when cattle will continue to be allowed to graze in the Upper Black Canyon and the South Diamond Creeks? I am tired of ONE rancher damaging 145,000 acres, 85% of it wilderness. And when I think of the cattle being favored over one of the first species worldwide to be considered endangered, and in the first U.S. wilderness, where man is supposed to be only a visitor walking lightly on the earth, it makes me angry. Cattle do not walk lightly on the earth! They compact the soil, resulting in increased runoff, which carries sediment into the creeks whose banks have been denuded by overgrazing. If the American people realized what was happening on their public lands, in their wildernesses, they would be incensed. Please study and monitor the way cattle activity degrades the Gila trout habitat (which should include the Upper Black Canyon and South Diamond Creeks). Wherever there is a conflict between cattle and trout, remove the cattle!

S. - I AM ACTUALLY SHOCKED TO FIND OUT THAT CATTLE ARE EVER ALLOWED TO GRAZE IN OUR WILDERNESSES. I AM NOT OPPOSED UNDER ALL CIRCUMSTANCES TO CATTLE GRAZING IN SOME FOREST SERVICE & BLM LAND - BUT GRAZING SHOULD NEVER BE ALLOWED IN OUR WILDERNESSES, ANYMORE THAN LOGGING OR MINING SHOULD BE.

Sincerely,

Billie M. Dreyfuss

Billie Dreyfuss



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9/12/92
SEP 14 '92

Reply To: 2670

Date: September 2, 1992

Jennifer Fowler-Propst
Field Supervisor
N.M. Ecological Services Field Office
3530 Pan American Highway, NE
Albuquerque, NM 87107

Dear Ms. Fowler-Propst:

Thank you for the opportunity to review the revised draft of the **Gila** Trout Recovery Plan. The Plan is well written and provides good background on the proposed recovery actions.

The **Gila** National Forest fully supports objectives outlined, and we look forward to continued cooperative work in accelerating recovery of this native species. When finalized, we will appreciate your continued help in providing necessary information to complete our required environmental assessments for projects proposed on the **Gila** National Forest. This enables management considerations of special areas, such as those within wilderness areas.

Acceleration of this work will be considered as funds and capabilities permit.

Sincerely,

la
MAYNARD P. ROSE
Forest Supervisor

____ Fowler-Propst 9/14/92
____ Donahoo
____ Adornato
____ Burton 9/1/8
____ A. Gully
____ B. Gully
____ Gonsen
____ Hamilton-McLean
____ Herring
____ Hughes
____ Jones
____ Kachm
____ Kay
____ Kenna
____ Ward



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Jennifer Fowler Propst
Field Supervisor
USFWS
3530 Pan Am Hwy. N.E.
Albuquerque, NM 87017

I am writing to comment on your office's draft updated Gila Trout Recovery Plan. As is well known, Upper Black Canyon Creek is an important part of the historic Gila Trout habitat. Please make it a priority reintroduction site. Specific reintroduction plans should also be developed and implemented as quickly as possible for the Main and South Diamond Creeks. All of these creeks (Upper Black Canyon, Main Diamond and South Diamond) and their surrounding areas should be part of the quarterly monitoring program. In particular, the effect of grazing activity should be monitored. Wherever grazing activity degrades or modifies the Gila Trout habitat, it should be regulated. If necessary, the cattle should be removed from Gila watershed areas they damage. I feel this is particularly true if those areas are in the Gila Wilderness. The Gila Wilderness was this country's first wilderness. It is one of our country's "crown jewels." Cattle activity which threatens an endangered species in a wilderness area is completely inappropriate.

Lucia White

95



THE WILDERNESS SOCIETY

Jennifer Fowler-Probst, Field Supervisor
U.S. Fish and Wildlife Service
New Mexico Ecological Services Office
Suite D, 3530 Pan American Highway NE
Albuquerque, NM 87107

RE: Comments on **Gila** Trout Recovery Plan (VIA FAX)

Dear Jennifer,

The following are comments of The Wilderness Society on the draft **Gila** Trout Recovery Plan. Gerry Burton, the information contact for this action, told me by telephone that the comments were due on September 17. Therefore, I am sending these to you by fax today. A hard copy will follow in the mail.

The Wilderness Society believes that the draft recovery plan is deficient in several respects:

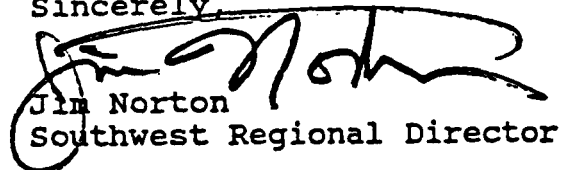
- 1) It fails to address and document the loss of 366 **gila** trout removed from Main Diamond Creek at the Mescalero and Dexter hatcheries or to plan for improvement in these facilities to ensure that these problems are corrected. I understand that 80% of the **gila** trout population has been lost in the last 3 years. This should be explained, documented and corrected.
- 2) Much stricter control of the damaging effects of livestock grazing should be included in the recovery plan. Livestock grazing directly reduces the population of **gila** trout by reducing water quality, increasing water temperature, altering habitat, etc. Because natural processes that have affected **gila** trout recovery (such as fire and floods) are largely beyond our ability to control, regulation of livestock grazing probably offers the greatest opportunity to recover the species. Furthermore, better livestock management can reduce the losses associated with natural processes such as fire and floods.
- 3) Reintroduction sites should be specified in the plan and grazing should be eliminated from critical reintroduction sites now to begin making them suitable for **gila** trout recovery.
- 4) A greater emphasis should be placed on establishing wild populations in natural habitat. Specific plans should be

3 prepared for Main Diamond and South Diamond Creeks and Black Canyon.

In addition The Wilderness Society agrees with and incorporates by reference the comments of the Sierra Club Legal Defense Fund, National Wildlife Federation and **Gila** Watch.

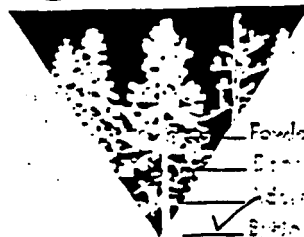
Thank you for providing me with the opportunity to comment on this plan.

Sincerely,



Jim Norton
Southwest Regional Director

FOREST GUARDIANS



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NEWS-AFO
9309
SEP 21 '92

Fowler-Propst 9/21/92

September 16, 1992

Ms. Jennifer Fowler-Propst
Field Supervisor
U.S. Fish and Wildlife Service
3530 Pan American Hwy N.E.
Albuquerque, N.M. 87017

Delivery via Facsimile

Re: Comments on draft Gila Trout Recovery Plan

Dear Jennifer:

Forest Guardians appreciates the opportunity to comment on the Gila trout Recovery Plan prepared by your office. I am disappointed that the plan has not taken critical steps necessary to provide for the long-term recovery of the Gila trout and fear that if this plan is adopted the Gila trout will become extinct in the wild.

More attention over a longer period of time has been devoted to the recovery and preservation of the Gila trout than almost any other endangered species in the Southwest yet the trout continues to be threatened with extinction. Listing the trout as endangered in 1966 initiated the current approach of preserving and replicating distinct populations in isolated headwater streams.

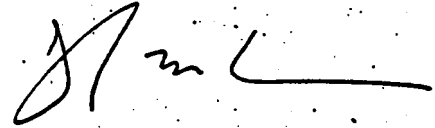
This approach is inconsistent with the principles of conservation biology and has recently been shown to be a failure. Perhaps 80% of the known Gila trout population has been lost in the past three years as a result of foreseeable stochastic events. Yet this draft plan continues to rely upon the maintenance of isolated gene pools and does not even include some reintroduction sites mentioned in the 1984 plan.

What is clearly warranted is a bold new approach that relies upon the best available information to provide adequate assurance of long-term recovery. At a minimum, entire drainages formerly inhabited by the trout must be reclaimed for reintroduction. Larger more diverse drainages provide security from natural events and facilitate the interaction of isolated gene pools which is essential to long-term survival.

5 Although much of the trout's habitat is protected from logging and road
construction, the draft plan ignores the impacts of overgrazing on riparian
habitats and the danger to the watershed of catastrophic fire as a result of
many decades of fire suppression. Natural fires, flooding and erosion are all
39 aggravated by overgrazing and fire suppression. Removing domesticated
livestock from all Gila trout watersheds and adopting a policy of controlled
burns must be considered.

Please send me the recovery plan when it is finalized.

Sincerely,

A handwritten signature in dark ink, appearing to read 'S M Hitt', with a long horizontal flourish extending to the right.

Samuel M. Hitt
director Forest Guardians



Southwestern New Mexico Audubon Society

P.O. Box 1473 • Silver City, NM 88062

Oct 13 1992

Fowler Propst

10/19/92

8/27/92

Jennifer Fowler Propst.
field Supervisor USFWS.
3530 Pm Am Hwy N.E.
Albuquerque NM 87017

Dear Jennifer,

For Shame! For Shame! It was terribly disheartening to see such a shamefull document as your draft revised Gila trout recovery plan come out of your office.

When will you ever come to admit that the one single most devastating factor in the decline of the Gila trout's habitat, and therefore numbers, is the "C" word.

1 is. Cattle. cattle have:

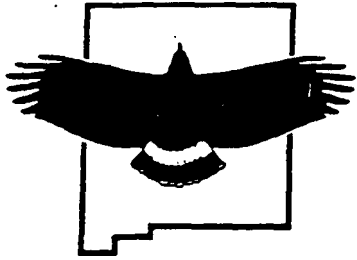
- removed protective cover from the streams allowing (guaranteeing) elevated stream temperatures.
- been "utilizing" grasses up to 90% (to a point where they are eating mullen and common thistle!) even during the rainy season which guarantees removal of topsoil (what's left) and sedimentation of streams, which bury the eggs of the Gila trout.
- 5 - destabilized the banks of the stream allowing (guaranteeing) more siltation & burying of eggs.
- increase Nitrogen levels in streams choking them with algae, & reducing O₂ levels.

It is mentioned that stream side vegetation has been reduced. By what? Aliens?
Complete what you've started to say. By cattle.



100

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Southwestern New Mexico Audubon Society

P. O. Box 1473 • Silver City, NM 88062

1/2
8/27/92

These Gila trout are going down while you placate the cattle industry by ignoring the cattle damage completely, in your plan.

I resent my tax dollars paying you to produce such a reckless document. You must acknowledge the damage cattle have done and continue to do to our ecosystem as a whole - uplands and riparian. You cannot find a solution until you recognize the problem.

In your final plan you must include:

- 5 - cattle as a man induced change (in depth)
- 7 - Monitor Main Diamond creek every year, not just the "coincidental" non grazed years.
- Demand Black Canyon be rested totally for an absolute minimum of Five years, and -
- 3 - Monitor the "amazing" recovery of Black Canyon in the process.
- 7 - include South Diamond with the same monitoring as main Diamond.

Ms. Jennifer Fowler Propst. - Don't be cowed any more. Take the bull by the horns! The Gila Trout are anxiously awaiting your enlightened plan.



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101

Very Sincerely,

Michael S. Souke

Gila Trout Recovery Plan

I am alarmed at the inadequacy of the new draft Gila Trout Recovery Plan. This plan must not be adopted until the following items are included:

- 1 - The negative effects of livestock grazing on riparian areas and watersheds must be recognized, and must be included as human activities that may have an adverse effect on recovery of the species.
- 5 - Provisions for monitoring of the effects of livestock grazing must be included. The monitoring system outlined for streams in the Aldo Leopold Wilderness in the draft are insufficient. Monitoring is not scheduled for years in which these pastures are grazed, and any grazing allowed must be strictly monitored.
- 1 - Provisions for the curtailment of grazing in the Aldo Leopold Wilderness and other areas must be outlined. Included would be an assessment of the condition of these areas now and the removal of cattle, if necessary, until recovery is adequate to sustain grazing with no adverse effects on gila trout habitat.
- 29 - Specific reintroduction sites must be included in the plan and the above provisions must also apply to these areas. Time-lines for reintroduction should be included.
- 30 - A full disclosure should be included in the history section of the plan, including the effects of grazing on the watershed of Main Diamond and South Diamond creeks prior to the Divide Fire, and the loss of the evacuated trout in the Mescalero and Dexter hatcheries subsequent to their evacuation.
- 7 - Specific recovery and reintroduction plans must be included for Main Diamond and South Diamond creeks. Grazing should be discontinued in these watersheds until complete recovery of the watershed, riparian areas and stream habitat has been effected.

Cathy Shultz, 40 Spry St, Pecos Alto, NM 88061
Marion C. 117 59 Silver City 88061
Shure, M. P.O. Box 81 N. M. 88049
Cecilia Jada P.O. Box 412, Silver City, NM 88062
Camela V. Thompson 1820 Virginia St. Silver City, NM. 88061
Alma D. 844125 Star at 15 N. M. 88061
Conne Lynch 1401 Virginia St S.C. N.M. 88061
Mike Lynch P.O. Box 976 S.C., N.M. 88062
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Vic Megnerep 45 Box 5611 Socorro NM.
William A. Stewart 921 12th St Silver City NM 88061
Dora Schmitt 8 Cinnamon St Silver City NM
Joe Schmitt HCR 88060, 9 JADE Dr. Silver City NM 88061

Gila Trout Petition

I am alarmed at the inadequacy of the new draft **Gila Trout Recovery Plan!** This plan must not be adopted until the following items are included:

- The negative effects of livestock grazing on riparian areas and watersheds must be recognized, and must be included as human activities that may have an adverse effect on recovery **of** the species.
- Provisions for monitoring of the effects **of** livestock grazing must be included. The monitoring system outlined for streams in the **Aldo** Leopold Wilderness in the draft are insufficient. Monitoring is not scheduled for years in which these pastures are grazed, and any grazing allowed must be strictly monitored.
- Provisions for the curtailment of grazing in the **Aldo** Leopold Wilderness and other areas must be outlined. Included would be an assessment of the condition of these areas now and the removal of cattle, if **necessary**, until recovery is adequate to sustain grazing with no adverse **effects** on **gila** trout habitat.
- Specific reintroduction sites must be included in the plan and the above provisions must also apply to these areas. Time-lines for reintroduction should be included.
- A full disclosure should be included in the history section of the plan, including the effects of grazing on the watershed **of** Main Diamond and South Diamond creeks prior to the Divide Fire, and the loss of the evacuated **trout** in the Mescalero and Dexter hatcheries subsequent to their evacuation.
- Specific recovery and reintroduction plans must be included for Main Diamond and South Diamond creeks. Grazing should be discontinued in these watersheds until complete recovery of the watershed, riparian areas and stream habitat has been effected.

Michael Sauber 707 W 8TH ST, Silver C.

628 Camino DE LA Luz SANTA FE NM

707 W 8TH St Silver City NM 88080

7425 SHERWOOD CREEK - W. BLOOMFIELD, N.M. 88322

300 E. Berger, Santa Fe NM, 87502, 87501

1785 E FRASER, Silver City, NM. 88061

1190 St. Francis Dr. Santa Fe, NM 875

GICIT ROUTE PETITION

Karen deGenervieve 5407 Hwy 90E SC. 88061

~~Brian H. Beard~~ Brian H. Beard P.O. 2856 S.C., NM 88061
Bryan Thomas 32 Owens Rd. SC. NM 88061

P. A. Lomo 2703 Sunrise St., S.C. N.M. 88061

Rex Johnson 713 W. 6th St Silver City, 88061

Bill Ege 620 S. Arizona SC. NM,

Carol Day 2069 Cottage San #1 Silvercity, NM 88061

Box 878 Silver City. - 88062

Bill Ege
Carol Day
M. H. Salmon

GILATROUT PETITION

Diane Harsh	Diane Harsh	Bx 101 Gila
Emily Robertsm	Emily Robertsm	Copper St, Silver C
Ed H. M. Ward	Ed Nehelrod	201 S. Nickel D.
Ernie J. Hohme		P.O. Box 1873, Leming
KEN STINNETT	Ken Stinnett	PO Box 1137
JEAN C. OSSORIO	Jean C. Ossorio	Mesa, NM 88001
MAY B. O'BYRNE	May B. O'Byrne	425 Holly St. Kansas City, MO 64106
Linda Keckfuss	Linda Keckfuss	3305 TOM LYONS DR. S.E. 88061
Ed Hinerman	Ed Hinerman	1050 Langstroth SC 88
BRIAN J. BRUESSEL	Brian J. Brüssel	1500 Montana SC 88
Laurie VanVliet	Laurie VanVliet	1718 Georgia St. SC 88
Johanna Herula		8 Cinnamon Tr. SC 88
C. Heyckamp		8 Cinnamon DR. SC 88
Bill Toth	Bill Toth	506 W. MARKET &
Gary Clouser	GARY CLOUSER	1823 VIRGINIA ST SC, NM 88
Rey Johnson		713 W 6th St Silver City
Wayne Mosteller	Wayne Mosteller	Box 1532 Silver City, NM 88001
ROF GOODMAN	ROF GOODMAN	P.O. B. 1312, Chatra NM, 87325
JULIE B. GOOD	JULIE B. GOOD	Don Bullard Silver City NM 88001
Deborah Cospers	Deborah Cospers	37 Spring Creek Road 88001
John P. Burke	John P. Burke	Silver City, NM 88001
Jennifer Ayarbe	Jennifer Ayarbe	Unit 78 Box 8 Silver City

GILA Trout (Petition)

Monica Rude	POB 263	Gila	NM 88038
Keith M. Moon	P.O.B. 280	Gila	NM. 88038
Steve Brown	P.O.B. 88	Gila	NM 88038

Appendix D

RESPONSES TO COMMENTS

1. The **Service** received numerous comments regarding the impacts of grazing upon **Gila** trout and **Gila** trout habitat. Therefore, a section was added to the recovery plan (page 28) , which discusses grazing within **Gila** trout habitat. Also, a section has been added to Part 2, page 37, which discusses thooe actions that should be taken to determine the impact of grazing upon **Gila** trout.
2. The plan as originally written does not promote grazing. For the moat part, grazing has not been an issue in attempting to recover **Gila** trout because most of the streams selected for recovery efforts were excluded from domestic livestock grazing due to their topography (steep and heavily wooded). South Diamond, Little, and **McKnight** creeks are the only streams presently occupied by **Gila** trout that are subject to grazing. Presently, **effoits** are being taken to limit or restrict that grazing by the **U.S. Forest Service**. These efforts include reevaluation of allotment management plans for the grazing allotments located within occupied **Gila** trout habitat.
3. The **Gila** Trout/Chihuahua Chub Recovery Team has developed criteria for selecting streams for renovation. Black Canyon **Creek** will be considered as a potential stream for renovation and **Gila** trout reintroduction according to the criteria.
4. The loss of approximately 80 percent of the **Gila** trout population within the last three **years** has been the result of natural events over which the U.S. Fish and Wildlife Service (**Service**) or the **Forest Service** have no control. These natural events included a forest fire started by lightning, a drought, and a severe flood. The resulting impacts of these natural events upon both historic and reintroduced populations of **Gila** trout emphasized the need to restore the species into larger and **more** diverse habitats where the impacts of natural events would not be so likely to devastate a population.
5. The plan has been modified to include consideration of grating impacts as a component of recovery. Included is the development and implementation of studies designed to monitor and assess the impacts of grazing upon **Gila** trout.
6. The population monitoring, as described in the draft recovery plan, is designed to provide information on the health of the **Gila** trout population in the various streams. It was not intended that this **monitoring** would also include efforts to determine the condition of **riparian** habitats under grazing and non-grazing conditions.
7. South Diamond Creek will be monitored on a frequency considered necessary by the recovery team. The special quarterly monitoring

program for Main Diamond Creek was for a duration of one year immediately following the fire that occurred in 1989. This one-year program was accomplished by the Recovery Team. Main Diamond Creek is now under a monitoring program of the Forest Service to record the overall recovery of the watershed from that fire. The data gathered by the Forest Service are made available to the recovery team. A specific reintroduction plan for restoring Gila trout into Main Diamond will be developed after it is determined that the stream is physically, chemically, and biologically able to support the species.

8. The grazing-of domestic livestock within the Aldo Leopold Wilderness is a permitted and lawful activity. A change in the law will be necessary if that activity is to be banned. However, grazing activity may be subject to section 7 consultation if the Forest Service determines that grazing "may affect" the Gila trout.
9. Comparative data are extremely difficult to gather and analyze because it is very difficult to find two streams with the same physical characteristics to compare. For example, the ratio of pools to riffles can greatly influence the number of trout a given stream, or reach of stream, can hold. There is a whole host of factors that determines a stream's ability to produce trout.
10. Use of toxicants is the only effective way non-native fish can be removed from a stream. If only one or two non-native fish remain in a stream they will genetically alter the genetic purity of the reestablished Gila trout population in the stream. While accidents do happen, and the toxicant may escape downstream and kill fish in a non-target area, if experienced individuals are conducting the treatment the chances of this happening are greatly diminished. Also, most of the areas where recovery efforts are either being conducted, or may be conducted, are far enough removed from the reaches of stream occupied by other native listed species that the toxicant, which neutralizes very rapidly, would not impact these species. Numerous studies have been conducted on the impacts of the toxicant, Fintrol, on other aquatic life. It was found that the toxicant will kill many aquatic invertebrates. However, it was also found that these invertebrates rapidly recolonized treated streams. Fintrol is not harmful to terrestrial wildlife.
11. Every effort is made when enhancing a stream for the benefit of Gila trout to blend the enhancement features with the natural surroundings. An excellent example of this is the stream barrier constructed on Iron Creek, which to the uninformed appears as a natural waterfall. To date, the only efforts that have been made to improve a Gila trout stream through the use of artificially constructed stream improvement structures have been on McKnight Creek, which is outside the known historic range of the species. The Civil Conservation Corps (CCC) put in structures on Main Diamond, South Diamond, and White Creek; the latter is planned to receive fish this fall.

12. The numerous log structures built by the CCC did result in an overpopulation of **Gila** trout in isolated pools, particularly during drought conditions. Most of the structures were destroyed by the flood that followed the 1989 fire. Analysis of the effects of a stream barrier is conducted during the review of the need **for** a structure for **Gila** trout recovery efforts. The potential for isolation and overpopulation constitute two important factors in such analysis.
13. Hybridization with the non-native rainbow trout is the principal factor that has caused the endangerment of **Gila** trout. It is not in the best interest for **recovery of** the species to promote or expand the range of hybrid **rainbow/Gila** trout. The ideal situation would be to have only **Gila** trout residing in suitable streams within the species' historic range.
14. Recovery efforts as described in the plan will lead to the downlisting and eventual recovery of the **Gila** trout. As recovery progresses, streams will be opened to fishing, at first on a limited basis, but then as **more Gila** trout populations are established, more streams will be available.
15. The public has had an opportunity to comment on recovery actions through public review and comment of the draft recovery plan. **Stocking** of fish for sport angling purposes will only be curtailed if it is determined that the stocking will negatively impact the **Gila** trout.
16. Helicopter use in the wilderness for the purposes of **Gila** trout recovery is limited to the transport of fish from one site to another site, during which the helicopter does not land.
17. Appropriate changes were made as suggested.
18. Construction of additional livestock watering tanks on the mesas above South Diamond and Black Canyon creeks is being proposed by the Forest service as a method to keep cattle from entering the riparian areas. If successful, it could result in better **Gila** trout habitat conditions in those two streams. The method by which the **Forest** Service proposes to construct the stock tanks is not considered within the purview of this recovery plan.
19. **Gila** trout artificially propagated in a hatchery will be used for reintroduction as described in tasks 2.4 and 2.5.
20. It is the intention of the recovery team to include larger and more stable **streams** in future recovery efforts. The team has also decided that a population of **Gila** trout will be developed in a hatchery that will consist of genetic input from several existing populations and that this stock would be the one to be used **for** recovery efforts once the five relictual populations have been successfully replicated and are secure.

21. The plan does include a task (1.43) that will evaluate the sport fishing potential of Gila trout. Initially, a stream containing Gila trout that has easy public access, such as McKnight Creek, would be opened to public fishing under special regulations. At the same time the stream is open to public fishing, studies would be conducted to determine the impact of angling upon the trout population. The information from these studies would then be used to manage sport fishing as more recovered populations are opened to anglers.
22. The Service concurs with the comment that protection of larger landscapes, such as watersheds, will greatly aid in the ecosystem stability that is critical to recovery of the Gila trout.
23. The Gila Trout Recovery Plan does not promote the movement of the species outside its historic range. Propagation of the species in a hatchery is required if sufficient numbers of the species are to be available for restocking into streams that have been renovated.
24. Part II of the recovery plan describes those actions that, if they are completed, would protect the species and expand its range and abundance to the extent that no natural or human-caused disturbance would result in irrevocable losses.
25. The objective, measurable criteria include the successful maintenance and protection of the five relict stocks, the identification of streams where the species can be reestablished, the removal of non-native trout and establishment of Gila trout into reclaimed streams, and the monitoring of existing and established populations. Each of these activities can be quantified.
26. Part three of the recovery plan (page 43) provides a schedule of the estimated time required to complete the various tasks and the estimated costs associated with each task.
27. The Service recognizes that recovery of the Gila trout cannot be accomplished by focusing recovery efforts on small headwater streams. The plan does provide for the expansion of recovery efforts into larger, more stable, stream systems. However, recovery efforts have to start in the headwaters because the primary reason for the endangerment of Gila trout has been and will continue to be hybridization with non-native rainbow trout. Thus, for a recovery effort for a given stream, large or small, to be successful, all rainbow trout must be removed from its headwaters downstream.
28. The plan, on page 15, contains the evaluation criteria that will be used to select candidate restoration streams.
29. Specific identification of potential recovery sites relies upon environmental conditions which, as evidenced by the Divide Fire, may undergo drastic changes in any given year. Specific sites for reintroduction efforts are recommended to the Service on an annual basis by the Gila Trout/Chihuahua Chub Recovery Team. The Service then

- recommends to the **Forest** Service that these sites be considered for renovation.
30. The Service, in cooperation with the **Forest** Service, removed 566 **Gila** trout from Main Diamond Creek while the Divide Fire was still in progress. These fish were taken to Mescalero National Fish Hatchery and placed in a **secure** area where they could not become accidentally mixed with rainbow trout. In October 1990, 200 of these fish were stocked into **McKnight** Creek. Most of the remaining fish were lost at the hatchery when a snake got caught in the water supply pipe and shut the water off to the tanks where the **Gila** trout were being held.
 31. Delisting criteria will be developed after downlisting goals have been achieved. The recovery team believed that it could not adequately address delisting criteria until more data are available.
 32. The literature is rich with published results of studies concerning the impacts of grazing in the western United States upon trout and their habitat. However, a review of this literature shows that most of these **studies** deal with higher latitude, lower elevation, mountain meadow streams. Few discuss the impacts of grazing upon headwater streams where grazing is excluded due to topography and a lack of forage.
 33. The Service does believe the criteria for downlisting are objective and measurable. Reintroduced populations will be considered as meeting the criteria for being established when monitoring of the populations indicates that they are reproducing successfully and the young are being recruited into the population (see **appendix A**).
 34. It **is** extremely difficult to prove physical take of **Gila** trout **because** of an ongoing activity such as livestock grazing. What are especially difficult to separate are the results of the many **factors**, both natural and human-caused, upon a stream and the population of fish **in** that stream. Fish populations are not static; they vary from year to year due to both natural and human-caused **events**. The *recovery* plan has been amended to include a discussion on grazing.
 35. Costs associated with "evacuations, temporary holding measures, **transplants**, and extensive habitat manipulation" are included tasks 2.4 and 2.5. Emergency responses to such occurrences **as** the Divide Fire cannot be budgeted in advance.
 36. A number 1 priority was given to those actions deemed necessary to prevent extinction of the species. Recovery actions that are taken to improve the status of the species were given a number 2 priority because it was considered that the species would not become extinct if such actions were not conducted.
 37. The statement that recovery efforts to date "have neither improved nor maintained the status of the **Gila** trout" is false. When recovery efforts were originally initiated, only five isolated populations of **Gila** trout existed. Today, 11 populations persist.

38. Grazing issues relative to Gila trout have been discussed under section 7 consultation procedures with the U.S. Forest Service.
39. We are aware of the serious problem that has been created by suppressing natural fires. The Service will continue to support the Forest Service in conducting a fire management program that includes letting natural fires in wilderness areas burn, and the use of prescribed burning to lower the risk of catastrophic fires.
40. Most of the streams that are suitable for recovering the Gila trout are located above the areas where the invasion of pinyon/juniper has occurred. Therefore, control of these species was not considered in the draft recovery plan.
41. The loach minnow is found in streams at lower elevations where trout are excluded due to temperature. At these lower elevations, siltation and erosion caused by excessive livestock grazing is a concern. However, at higher elevations where livestock grazing is excluded due to topography and a lack of forage, erosion and siltation are of much less concern.